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7th Annual Symposium
on the Role of Behavioral
Science in Physical Security

The Human Element in
Organizational Sensitivity

16-17 November 1982
Naval Surface Weapons Center
White Oak, Maryland 20910

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AGENDA

7th ANNUAL SYMPOSIUM ON THE ROLE OF BEHAVIORAL SCIENCE IN PHYSICAL
SECURITY: THE HUMAN ELEMENT IN ORGANIZATIONAL SENSITIVITY

Tuesday, 16 November 1982

0800-0900   Registration

0900   Opening Remarks

             Administrative Announcements

             "You Have No Right to Make Me Think About This!" The
             De-Legitimation of Current Nuclear Policies Among Key American Elites
                 Richard G. Davies, Culver Military Academy

             "Anomic Behavior and the American Soldier: Problem or Prospect?"
                 Gregory D. Foster, Abt Associates

             BREAK

             "Utility Considerations in Emotional Stability Monitoring for
             Nuclear Plant Personnel"
                 Sandra L. Davis, Ph.D., MDA Consulting Group
                                       Personnel Decisions Research Institute

             "Cognitive Complexity and Task Demand as Joint Indicators of
             Behavioral Reliability"
                 Michael L. Fineberg, Ph.D. and Robert W. Swezey, Ph.D.,
                 Science Applications, Inc.

1230-1330   LUNCH

1330   "Human Reliability as a Factor in Security"
                 Robert P. Bateman, Ph.D., Systems Research Laboratories, Inc.

             "A New Approach to Security Analysis"
                 Henry C. Alberts, MRJ, Inc.

             "Teaming Human and Artificial Intelligence for High Productivity
             Security Systems"
                 Pierre Bierre, Sylvania Systems Group Western Division,
                 GTE Products Division

             BREAK

             "Security System Operational Recording and Analysis (SSORA)"
                 Robert R. Mackie, Ph.D., Human Factors Research, A Division of
                 Canyon Research Group, Inc.
                 Robert J. Hall, Ph.D., Centennial Research, Inc.

             Meet with presenters for further discussion as desired.

1700-1900   SOCIAL HOUR

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Wednesday, 17 November 1982

0800-0900   Registration

0900   "The Feasibility of a Light and Sound System for Delaying
             Intruders into Secure Facilities"
                 Ben H. Sharp, Ph.D., Wyle Laboratories

             "The Man/Machine Interface as Impacted by the Ecology of the
             Security Person"
                 Clifford E. Simonsen, Ph.D., and Alexander G. Schauss, American
                 Institute for Biosocial Research

             BREAK

             Panel Discussion (Panel composed of speakers)
                 Comments and Opinions on Current Behavioral Research and Future
                 Needs

             Closing Remarks

             Administrative Time

             Meet with day's presenters for further discussion as desired.

1300   End of Symposium

ANOMIC BEHAVIOR AND THE AMERICAN SOLDIER:
PROBLEM OR PROSPECT?

Gregory D. Foster
Abt Associates Inc.

BIOGRAPHICAL SKETCH

Gregory D. Foster currently is with the Defense Analysis Group
of Abt Associates Inc., in Cambridge, Massachusetts. A West Point
graduate and former Regular Army officer, Mr. Foster holds graduate
degrees in systems management and public administration. Prior to
joining Abt Associates, he was Director of Research and Washington
office manager of the Foreign Policy Research Institute.

INTRODUCTION

In this era of "warfare by deterrence," it has become increasingly difficult to distinguish the good soldier from the bad. It has long been recognized that the good peacetime soldier may possess attributes that ill-equip him to cope successfully with the terror of war, while the mediocre peacetime soldier who cannot (or will not) conform to the mundane routine of garrison life may prove indispensable and uniquely well-adjusted under wartime stress.

During protracted periods of peace, particularly where there is common understanding that the avoidance of war in its traditional sense is the driving imperative, the military operates like any other bureaucratic organization. Efficiency is the global criterion of performance (appropriate rhetoric being accorded, of course, to the importance of readiness, preparedness, and combat effectiveness), and routinization, uniformity, and predictability are sine qua nons, however contrived. Under such conditions, both individual and organizational effectiveness become especially hard to define, much less to measure.

In contrast, combat provides a defensible pretext for the dissolution, or at least for the drastic alteration, of established norms of behavior. Even where selective adherence to chivalric custom occurs, there exists a legitimated outlet for frustration and aggression that is not present in peacetime. What, under different circumstances, would be considered extreme forms of deviant behavior--killing, destruction, deception, and stealing-- become not merely acceptable but, in many cases, standards of excellence. Furthermore, in combat the instinct for survival engenders a degree of individual responsibility that otherwise may not be so pervasive (or even present) in peacetime. The danger of imminent death provides a cohesive epoxy that is virtually impossible to replicate in different milieux.

In the absence of more tangible evidence, one must assume the existence of some correlative, or even causal, relationship between "good soldiering" and unit cohesion, the inherently nebulous construct that has assumed such considerable influence in recent years in the literature of military sociology. As postulated by Shils and Janowitz in their pioneering study of the subject:

> It appears that a soldier's ability to resist is a function of
> the capacity of his immediate primary group (his squad or
> section) to avoid social disintegration. When the individual's
> immediate group, and its supporting formations, met his basic
> organic needs, offered him affection and esteem from both
> officers and comrades, supplied him with a sense of power and
> adequately regulated his relations with authority, the element
> of self-concern in battle, which would lead to disruption of
> the effective functioning of his primary group, was minimized.[1]

Unfortunately, those who have dealt with the subject of cohesion have shed little light (perhaps because there is little to be shed) on its identification and measurement during peacetime and, more importantly, on the individual qualities that contribute to it. Typically, cohesion is dealt with more-or-less phenomenologically as something that emerges from such things as discipline, leadership, and training, all of which are seen as means of fulfilling individual learned needs.[2]

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The difficulty of defining cohesion has led most analysts to accept the notion that it represents the obverse of disintegration and thus is character-ized by the absence of those conditions that have been suggested as contributing to the latter--e.g., desertion, mutiny, the assassination of leaders, and other behaviors at odds with discipline, such as drug usage. It has been suggested, either explicitly or implicitly, that such phenomena in turn are reflections of alienation, the psychological withdrawal or separation of a person or his affections from an object or position of former attachment. The natural infer-ential extension of this argument is that the breakdown of cohesion is a direct function of the prevalence of alienation.

The increasing appearance of alienation as subject matter in the military literature is evidence of an attempt to marry two chic ideas for explanatory purposes.[3] However apt this marriage may appear to be, to accept it alone at face value is to ignore other perhaps equally important, though neglected, psychological and social phenomena that may have appreciable impacts on cohesion. One such phenomenon is the concept of anomie, a state of normlessness or lawless-ness that is characterized by individual disorientation, anxiety, and social isolation.

Anomie has received little notice to date as a condition affecting today's soldier. Though no less nebulous a construct than alienation, anomie[4] focuses on a range of social variables not adequately addressed by alienation. As tenuous as the empirical link between alienation and cohesion may be, its intuitive appeal engenders a certain logic that cannot be discounted. The same, therefore, must be said of anomie and its potential relationship to cohesion. The purpose of this inquiry will be to shed some light on the definitional bounds of anomie, to speculate on how it can be identified and diagnosed, and, to the extent that anomie can be adduced to be what it is said to be, to suggest how the military as an institution can cope with it.

ANOMIE--DEFINITIONAL BOUNDS AND DIAGNOSIS

The term anomie first was used by Emile Durkheim in his famous study Suicide, published in 1897. He derived the term from the Greek and transliter-ated it into French. To the negative prefix a-, he added the plural of laws, nomous, and turned the "no-laws" of anomous into French as l'Anomie. As part of the study, Durkheim developed a theory of human needs and aspirations to explain variations in suicide rates among different social groups at different times. He identified three types of suicide: (1) egoistic suicide, which arises from the fact that individuals no longer see any reason for staying alive; (2) altruistic suicide, resulting from the fact that this reason seems to them to lie outside life itself; and (3) anomic suicide, which arises from the fact that individuals' actions become ruleless, and that the individuals suffer from this condition. The social condition of anomie becomes manifest at the individual level as uncertainty over proper action and belief. If an individual is unable to cope with the anxiety produced by this uncertainty and insecurity, he may be driven to take his life.[5]

Others since Durkheim who have treated the subject of anomie have defined it thusly:

- Cary-Lundberg: "...social disorganization, discarded and discredited norms; a flat unwillingness to accept in any form a checkrein on pleasure, appetites, production or prosperity...."[6]

- Parsons: "...the polar antithesis of full institutionalization..., the absence of structured complementarity of the interaction process or, what is the same thing, the complete breakdown of normative order...."[7]

- Hampden-Turner: "...a severe state of underdevelopment with relative weakness instead of strength in the segments of the (individual psycho-social development) helix."[8]

- Horton: "...system imbalance or social disorganization--a lack of or breakdown in social organization reflected in weakened social control, inadequate institutionalization of goals, inadequate means to achieve system goals, inadequate socialization, etc."[9]

- MacIver: "...the state of mind of one who has been pulled up by his moral roots.... The anomic man has become spiritually sterile, responsive only to himself, responsible to no one. He lives on the thin line of sensation between no future and no past."[10]

- McClosky and Schaar: "...a state of mind, a cluster of attitudes, beliefs, and feelings in the minds of individuals... the feeling that the world and oneself are adrift, wandering, lacking in clear rules and stable moorings. The anomic feels literally de-moralized; for him, the norms governing behavior are weak, ambiguous, and remote."[11]

Robert Merton has gone a step further in acknowledging that anomie may vary in degree and in kind. He distinguishes simple anomie--the state of confusion in a group or society which is subject to conflict between value systems--from acute anomie--the deterioration and, at the extreme, the disintegration of value systems.[12]

Various studies of revolutionary behavior have cited anomie as a contributing factor. Almond, for example, has cited anomic interest groups as "the more or less spontaneous penetrations into the political system from the society, such as riots, demonstrations, assassinations, and the like." He concedes, however, that much of what passes for anomic behavior is really the use of unconventional or violent means by organized groups.[13]

Similarly, Gurr and Hagopian have referenced anomie in their analyses of revolutionary behavior. The former cites Sebastian de Grazia, who attributes revolutionary violence to acute anomie. Gurr further implies an inverse relationship between anomie and "ideational coherence" when he states: "Some of the most general explanations of the origins of revolution and other forms of collective violence attribute it to the loss of ideational coherence: men's loss of faith in, or lack of consensus about, the beliefs and norms that govern social interaction."[14]

Hagopian likewise notes that highly dissynchronous social change encourages a general sense of malaise through the breakdown of certain values and beliefs (anomie). It is not necessarily change per se that is so disorienting, argues Hagopian, but the hodge-podge of old and new that undermines old guidelines and verities, and perhaps intimates the possibility of something new and better.[15]

Sociologist Peter Berger has provided perhaps the harshest indictment of anomie in referring to the effects of "anomic terror":

> ... separation from the social world, or anomy, constitutes
> such a powerful threat to the individual. It is not only that
> the individual loses emotionally satisfying ties in such
> cases. He loses his orientation in experience. In extreme
> cases, he loses his sense of reality and identity. He becomes
> anomic in the sense of becoming worldless... the fundamental
> order in terms of which the individual can "make sense" of his
> life and recognize his own identity will be in process of
> disintegration.... The socially established nomos [a meaningful
> order] may thus be understood, perhaps in its most important
> aspect, as a shield against terror.... The ultimate danger of
> [separation from society] is the danger of meaninglessness.
> This danger is the nightmare par excellence, in which the
> individual is submerged in a world of disorder, senselessness
> and madness. Reality and identity are malignantly transformed
> into meaningless figures of horror. To be in society is to be
> "sane" precisely in the sense of being shielded from the
> ultimate "insanity" of such anomic terror. Anomy is unbearable
> to the point where the individual may seek death in preference
> to it.[16]

Such agreement as exists among these various interpretations of anomie tends to center around its subsumption of the negative side of man's adjustment to and acceptance of societal and institutional norms. In the final analysis, anomie may be merely a "panchreston," a word which, in attempting to explain all, essentially explains nothing.[17] As noted by one pair of observers, anomie may not actually be a specific and isolable condition clearly distinguishable from other moral-psychological states. Rather, it may be but one dimension of a many-sided malaise, one of many symptoms expressing a negativistic, despairing outlook on one's life and environment.[18] Nonetheless, as a general rubric, it is a concept not without merit that warrants more than a modicum of attention.

The generally accepted explanatory model of anomie takes the following form: social condition ——> psychological state ——> deviant behavior. In other words, a particular socio-cultural condition gives rise to selected individual feelings, which in turn produce specified deviant behaviors. Durkheim and Merton have provided the most comprehensive treatments of the social conditions that lead to anomic behavior. In Durkheim's view, anomie is endemic in modern societies; it is especially virulent in the economic sector where all the customary restraints and moral limits on man's aspirations are undermined by the capitalist ethic of greed and gain. This weakening of restraints gives man a feeling of wandering through an empty space with no landmarks from which to take a bearing and set a course. Society imposes no limit on man's "insatiable and

bottomless" cravings for wealth, prestige, and power, and when a man's goals are infinite, his strivings are futile. Thus, each step upward only discloses a further infinitude; each success turns into another failure. Man thirsts for novelty, for unknown delights, for nameless sensations, which nevertheless lose all their zest as soon as they are experienced. Then, when the slightest reverse occurs, man is powerless to bear it.[19]

Whereas Durkheim conceived of man as a bundle of passions which can be tamed only by social restraints, Merton examined the social pressures acting upon individuals to violate accepted codes of behavior. In contrast to Durkheim, who maintained that anomie was produced by an economic ethic that removed all limits from greed, Merton saw anomie as the result of a breakdown in the cultural structure, occurring particularly when there is an acute disjunction between the cultural norms and goals and the socially structured capacities of members of the group to act in accord with them. When the cultural and social structures are malintegrated, the first calling for behavior and attitudes precluded by the second, there is a strain toward the breakdown of norms.[20]

Merton's basic position was that the culture enjoins the acceptance of three cultural axioms: first, that all should strive for the same lofty goals, since these are open to all; second, that present seeming failure is but a way station to ultimate success; and third, that genuine failure consists only in the lessening or withdrawal of ambition. Thus, Merton and Durkheim were in fundamental agreement on the basic argument that the ardent pursuit of certain essentially unlimited societal goals by that society's members may lead to the virtual collapse of normative restraints and produce a strain toward anomic behavior.[21]

In support of his contention that anomie is brought on by the acute disjunction between societal goals and the means for attaining them, Merton pointed to five types of adaptive behavior that individuals manifest in coping with the goals-means dilemma. These modes of adaptation are summarized below.

Means of Adaptation	Culture Goals*	Institutionalized Means*
I. Conformity	+	+
II. Innovation	+	−
III. Ritualism	−	+
IV. Retreatism	−	−
V. Rebellion	±	±

*(+) signifies "acceptance", (−) signifies "rejection" and
(±) signifies "rejection of prevailing values and substitution of new values".

Conformity is manifested by the individual who accepts both the goals and the means of the society. It constitutes non-deviant behavior and thus is the modal response not only of the military careerist but of American society as a whole. The Innovator, on the other hand, while continuing to accept society's goals, has rejected the means available for attaining them and turns to some alternative. In this setting a cardinal American virtue - "ambition" - promotes a cardinal American vice - "deviant behavior." Similarly, Ritualism results when the individual who has internalized the institutional values fully

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rejects the success aspiration. Such behavior is personified by the stereo-
typical, conformist bureaucract. This leads Merton to pose the question whether
this represents truly deviant behavior. Since the adaptation is, in effect, an
internal decision and since the overt behavior is institutionally permitted,
though not culturally preferred, it generally is not considered to represent a
social problem. Yet, as Merton himself points out, it clearly represents a
departure from the cultural model in which men are obliged to strive actively,
preferably through institutionalized procedures, to move onward and upward in
the social hierarchy.

Just as Adaptation I ("conformity") remains the most frequent, Adapta-
tion IV ("the rejection of cultural goals and institutional means") is probably
the least common. People who adapt (or maladapt) in this fashion are, strictly
speaking, _in_ the society but not _of_ it. Sociologically, these Retreatists
constitute the true aliens (psychotics, autists, vagrants, chronic drunkards,
drug addicts, etc.). Not sharing the common frame of values, they can be
included as members of the society (as distinguished from the population) only
in a fictional sense.

Finally, when the institutional system is regarded as the barrier to the
satisfaction of legitimized goals, the stage is set for Rebellion as an adaptive
response. This adaptation leads men outside the environing social structure to
envisage and seek to bring into being a new, or greatly modified, social struc-
ture. It presupposes alienation from reigning goals and standards, which come
to be regarded as purely arbitrary. Thus, allegiance must be withdrawn from the
prevailing social structure and transferred to a surrogate, non-frustrating
alternative.

At the individual level, anomie manifests itself in forms that at best
may be difficult to discern. The work of Leo Srole and of McClosky and Schaar
provides some potentially useful insights in this regard. Srole devised a
five-item scale to measure the attitudinal-ideational components of the anomic
mind that he had postulated.[22] The extent to which an individual indicates
agreement with the following scale items purportedly suggests the presence of
some level of anomie:

- "In spite of what some people say, the lot of the average
  man is getting worse."

- "It's hardly fair to bring children into the world with the
  way things look for the future."

- "Nowadays a person has to live pretty much for today and
  let tomorrow take care of itself."

- "These days a person doesn't really know who he can count
  on."

- "There's little use writing to public officials because
  often they aren't really interested in the problems of the
  average man."

The first item in the Srole scale is said to measure the individual's
view, beyond abdication of future life goals, that he and people like him are

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retrogressing from the goals they have already reached. The second question measures the deflation or loss of internalized social norms and values, reflected in extreme form in the individual's sense of the meaninglessness of life itself. The third question is intended to measure the individual's perception of the social order as essentially fickle and unpredictable, i.e., orderless, inducing the sense that under such conditions he can accomplish little toward realizing future life goals. The fourth and fifth questions were constructed to measure respectively the individual's perception that his framework of immediate personal relationships, the very rock of his social existence, was no longer predictive or supportive and the individual's sense that community leaders are detached from and indifferent to his needs.[23]

Collectively, such views seem to represent a state of mental despair, of utter hopelessness and discouragement. In a meaningful, identifiable sense, the individual possessed of such despair is likely to be not merely languorous and indolent but totally apathetic and, in the extreme, hostile and disruptive. Still, short of such overt behavior, the identification of anomic tendencies probably will resemble, in terms of rigor, the reading of animal entrails.

McClosky and Schaar have gone further in attempting to clarify the attitudes, beliefs, and opinions characteristic of the anomic individual. They argue that anomie is governed not only by one's position and role in society but also by one's intellectual and personality attributes. Just as the norms of society are learned, so too are anomic feelings that there are no norms. Therefore, whatever interferes with learning societal norms tends to increase anomic feelings among society's members. There appear to be three categories of personal factors that impair learning and socialization: (1) cognitive factors that influence one's ability to learn and understand; (2) emotional factors that tend to lower one's ability to perceive reality correctly; and (3) substantive beliefs and attitudes that interfere with successful communication and interaction. Cognitively, highly anomic individuals tend to be low in education, intellectuality, and awareness, while being high in mysticism (belief in such things as spiritualism, necromancy, astrology, and prophecy) and acquiescence. Emotionally, they are highly inflexible and reflect high degrees of anxiety and generalized anger and aggression, while being low in ego strength. Substantive beliefs and attitudes characteristic of the highly anomic person include high totalitarianism, fascist values, left wing/right wing political orientation, Calvinism (the tendency toward judgmentalism and severity in one's demands upon others), elitism/inequalitarianism, and ethnocentrism, and low tolerance and faith in people.

McClosky and Schaar are led to question whether the standard explanatory concepts employed for anomie--social dysfunction, malintegration between culturally approved goals and institutionalized means, discrepancy between aspiration and achievement, the limitless nature of the success imperative, or the presumed human need for clear limits--are necessary, sufficient, or even most appropriate. An alternative and possibly more useful approach, they suggest, might be to regard anomie as a by-product of the socialization process--a sign of the failure of socialization and of the means by which socialization is achieved, namely, communication, interaction, and learning.[24]

Even where agreement on the recognizable manifestations and underlying causes of anomie is not readily forthcoming, sensitivity to the existence of the phenomenon and some sense of the range of identifying characteristics and

precipitants provides initial grounds at least for formulating an institutional response to the problem.

FRAMING AN INSTITUTIONAL RESPONSE

There is no more reason to believe that anomie does not exist, nor that it is not what it is said to be, than to conclude the opposite. The essentially tautological nature of the construct must not be allowed to obscure the fact that it serves a useful purpose in embracing a variety of real and perceived social ills. The challenge, therefore, is not to discard the phenomenon but to accept its existence in some form and in some degree of pervasiveness and attempt to deal with it.

Regrettably, today's military gives little evidence of being a learning environment in which counter-anomic socialization can flourish. A true learning system has the ability to adapt, to adjust, and itself to exert appreciable influence on the governing environment. It is a well recognized fact that the military traditionally has lagged other sectors of societal development.[25] What is less well recognized is that, under conditions of deterrence, the military is not merely an inertial bureaucracy but an intrinsically, perhaps uniquely, anomic institution. Although the environment is structured, it is normless -- there being a constant tension between combat norms and non-combat behavior. In the absence of combat, there is no legitimate measure of combat effectiveness, only surrogate pseudo-measures of readiness. The result is an acute disjunction that manifests itself most clearly in questions of how much discipline and how much training are enough.

A companion disjunction, more directly akin to that posited by Merton, exists within the career structure: the common, almost universal desire to achieve high rank, driven by an "up-or-out" mentality, juxtaposed against limited opportunities and means for attaining such status. In other words, everyone wants to be a general, but few actually can be one. The frustrations of waiting for the promotion system to catch up with performance, of matching advancement with competence, is acute. Thus, the winnowing process for determining who reaches the top may be based less on survival of the fittest than on survival of the most resilient.

Experience has shown that, all too frequently, the "demands" of peace-time foster conformist and even ritualistic behavior, while discouraging the innovation that may prove so invaluable in wartime. Unfortunately, in the absence of hostilities, such innovation presents a destabilizing threat to institutional norms, at least as seen be those in positions of authority. The accessibility of drugs and alcohol in today's environment and the tedium of garrison life make retreatism an increasingly prevalent response. Fortunately, given the availability of alternative career opportunities, even in time of economic hardship, it is unlikely that rebellion, at least of any significant magnitude, will become a commonplace response in the American military.

It is toward this end -- the eradication or amelioration of rebellious, dissident behavior, and even of disruptive, dysfunctional retreatist behavior-- that the institution must direct its efforts.[26] Two interrelated approaches, each of which in different measure can contribute to this end, should be encouraged. The first, most obvious, and most commonly proposed is that appropriate systemic adjustments be made to remove the conditions that breed unwanted behavior.

The second, less obvious, but potentially more enduring approach is to make appropriate intellectual adjustments so that anomic behavior can be viewed in other than a pejorative sense and instead as something with possible positive, contributory consequences that can facilitate accomplishment of the military's peacetime and wartime missions.

Of the numerous systemic adjustments that could be made, three in particular warrant mention. The first of these concerns the need for institutional de-regulation. The anomic, or potentially anomic, individual typically enters the military perhaps unwittingly in search of the behavioral anchoring that is missing from his life. To him the military, with its hierarchal pattern of authority and its reputation for strict discipline, represents structure. In choosing this course, he mistakenly opts for rules and regulations, of which there are an overabundance, rather than normative robustness, of which there is a dearth. It may, in fact, seem paradoxical that de-regulation is proposed as a solution to a problem that has been defined as de-regulation. This, however is nothing more than semantic confusion.[27] Just as in society at large, where legalistic measures have usurped moral resolution of most social problems, the military is a repository of an inordinate amount of regulation designed, for the sake of convenience, to reduce ambiguity and complexity by standardizing behavior. Exhaustive lists of do's and don'ts assume greater importance and acceptability than standards of right and wrong.

Whatever may be said to the contrary, soldiers are inculcated from day one with a can-do attitude, taught to accept orders from superiors, to be followers who respond rather than leaders who initiate. Regulations, therefore, assume an aura of holy writ -- edicts from omnipotent, omniscient superior authority -- even to those who know how regulations are generated. Even where such regulations are illogical or create discomfiture, they tend to be accepted. Because, in actuality, regulations are generated perfunctorily by a very few individuals -- staff officers who are merely mortal functionaries -- they do not come close to representing the consensual institutional values they purport to be. Consequently, in the sense of normative robustness, the system is a sham. The end result is excessive overregulation that leads in turn to selective enforcement and arbitrariness, thereby producing the disaffected hopelessness and despair that is anomie. What is needed, rather than the existing system of top-down, prescribed norms is one of bottom-up, emergent norms which reflect the values of those sub-strata deemed most important and valuable to the institution. This suggests a drastic curtailment of regulations, a commensurate reliance on more-or-less spontaneous value imperatives, a flattening of hierarchal structures, and, most importantly, a diffusion of authority to those levels where actual responsibility for institutional performance resides.

A second systemic adjustment would involve the rationalization of policies and programs to ensure the internal consistency and compelling logic of established standards of conduct. The peacetime military, as a quintessentially bureaucratic institution, prizes efficiency in the Weberian sense above all else. This leads inevitably to a certain depersonalization of the individual. It is reasonable to presume that most individuals can accept (even if they cannot understand) such depersonalization if it seems clear that there is a compelling rationale, that the organization or the institution "knows" where it is going. Too rarely, however, does this seem to be the case.

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Disciplinary policy is perhaps the best available expample of a lack of direction and of the ambivalance that attends the deterrent posture of the military. Although the idea of discipline has been institutionalized, its substance and practice have not. To be sure, we have advanced considerably in the 2000 years since Euripides noted: "A large army is always disorderly." But, as war in the traditional sense becomes an increasingly remote possibility, as public awareness and disaffection with authority rise, and as the military becomes more heavily populated by large percentages of highly trained technical specialists, the proper course of discipline becomes less clear. This may help explain why Army Regulation 600-20, Army Command Policy and Procedure, the primary source of grand policy direction for the Army, devotes almost four times as much space to haircut specifications as it does to discussion of the disciplinary powers of the commanding officer, nearly twice as much as to the exercise of military authority, and about the same as to the relationship of superiors to subordinates.

The somewhat vacuous nature of extant policy in this regard is captured clearly by the following statement from AR 600-20:

> [Military discipline] generally is indicated in an
> individual or unit by smartness of appearance and action;
> by cleanliness and neatness of dress, equipment, and
> quarters; by deference to seniors; by mutual respect between
> senior and subordinate personnel; and by the prompt and
> cheerful execution by subordinates of both the letter
> and the spirit of the legal orders of their lawful superiors.

Such statements provide remarkably little useful guidance, nor do they seem to represent collective institutional values in a practical sense. The problem is exacerbated by the fact that disciplinary policy is hopelessly intermixed with military justice. In effect, AR 600-20 must "compete" as a source of authoritative guidance with the Uniform Code of Military Justice (UCMJ) and the Manual for Courts-Martial (MCM). As the Powell Report, submitted to the Secretary of the Army in 1960, argued:

> . . . it is a mistake to talk of balancing discipline and
> justice -- the two are inseparable . . . . It is not
> proper to say that a military court-martial has a dual
> function as an instrument of discipline and as an instrument
> of justice. It is an instrument of justice and in fulfilling
> this function it will promote discipline.

Rationalization of disciplinary policy, as of other policies and programs, must start with the establishment of a firm philosophical foundation of purpose and intent -- a recognition and acceptance of what discipline is meant to accomplish in the contemporary environment. T.E. Lawrence (of Arabia) has provided, although controversial, probably the most definitive statement of discipline's purpose:

> Discipline, in the sense in which it is restrictive
> [is] submergent of individuality, the Lowest Common
> Denominator of man. In regular armies in peace it
> means the limits of energy attainable by everybody
> present: it is the hunt not of an average, but of an
> absolute...The aim is to render the unit a unit, and

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the man a type, in order that their effort shall be
calculable, their collective output even in grain and
in bulk. The deeper the discipline, the lower the
individual efficiency, and the more sure the performance.
It is a deliberate sacrifice of capacity in order to
reduce the uncertain element, the bionomic factor, in
enlisted humanity.

Lawrence's belief might provide a useful first step toward rationa-
lizing that which now is fundamentally non-rational, fragmented, and confused.
In this sense, the current policy only feeds anomic tendencies. It would be
a mistake, however, to conclude that rationalization necessarily implies the
lowering or compromise of standards. Only where established standards are at
odds with prevailing societal values and cannot convincingly be demonstrated
to contribute to the accomplishment of institutional missions should they be
so altered. As General Maxwell Taylor has observed:

I am unalterably opposed to the concept that the
Army is merely a segment of American society which wears
a uniform but which otherwise should live as nearly as
possible as civilians live. That standard is not good
enough for the military profession which, like the church,
the law and the medical profession, has a special commit-
ment which requires special standards of behavior.

Yet a third systemic adjustment would link the amelioration of anomic
behavior to the intuitively grasped but rarely analyzed phenomenon of compe-
tence perception. All individuals enter the military with some expectation of
soldierly performance from their superiors-to-be--the professionals who make
the institution what it supposedly is. Despite the absence of rigorous
empirical and even theoretical underpinnings, some notion of competence
invariably figures into such expectations. Each individual has his own
ill-defined, intuitive feel for what constitutes competence, and he continu-
ously judges his superiors against these standards. It makes little differ-
ence how competent a superior actually is, but rather how competent he is
perceived to be. N.F. Dixon, in his interesting study On the Psychology of
Military Incompetence, contends that, historically, incompetent leaders have
tended to display a number of recognizable traits and behaviors, not least
among these being fundamental conservatism, passivity, indecision, obstinate
persistence, and suppression of new information.[28]

It is reasonable to presume that the individual who enters a structured
hierarchy expects the assumption of responsibility by those above him whom he
perceives to hold various degrees of authority. While supervisors generally
complain about not having authority commensurate with their responsibilities,
subordinates expect and have a right to enjoy an assumption of responsibility
by their superiors that is commensurate with the latters' perceived possession
of authority. Where there is a discrepancy, a perception of normlessness and
a consequent feeding of anomic tendencies is likely to result. Thus, there is
a compelling need, as one observer has noted, to raise competence to the
level of an ethical imperative.[29]

Only to a very limited extent can the lowering of *expectations* be considered a reasonable way to deal with competence perception. Individuals entering a profession that eventually may require them to risk their lives have every right to entertain high expectations. Conversely, they themselves must be the objects of high expectations *from others*—superiors, peers, and subordinates alike—the expectation being that they assume greater levels of personal responsibility. Where there are not such expectations, there is no incentive, other than self-gratification, to achieve.

One of the most intrusive influences from society, in fact, is the ubiquitous push toward legalistic anonyomity and the diffusion of responsibility. What we have witnessed for some time now is an emphasis on individual rights and collective responsibility that effectively has displaced the more ideal and normatively robust emphasis on individual responsibility and collective rights. When individuals are not held accountable for their own actions, yet are required to share the burden for the actions of others, they are cut adrift from prevailing norms and left to think that anything goes. Anomie is only exacerbated where this societal tendency is embraced, where perceived incompetence is tolerated and even rewarded. The problem seems best dealt with by:

- Encouraging reciprocal superior-subordinate loyalty. In contrast to the unidirectional, upward-directed loyalty commonly expected by superiors, reciprocal loyalty fosters rapport as well as individual strength and growth by comforting subordinates in the belief that their superiors will (1) shoulder responsibility for <u>the consequences</u> of subordinate mistakes (as distinct from the mistakes themselves, for which the individual concerned must be held accountable) and (2) give proper credit where credit is due for positive performance.

- Promptly and visibly applying positive or negative sanctions, as appropriate, directly tied to performance. As obviously desirable and acceptable as such measures are, bureaucratic procedures too frequently inhibit their effectuation. The ultimate objective, of course, is to produce acceptance of an adherence to institutional norms without the imposition of sanctions—more *spontaneity* and less *conditioning*. While sanctions may foster respect, they also may breed contempt if misused or overused.

- Eliminating the "zero defects" mentality that permeates the institution and the larger society. By demanding mistake-free performance, this mentality destroys the learning process and actually encourages deviant behavior in the form of lying, forced compliance, and the avoidance of responsibility. Furthermore, it contributes to anomic behavior by creating the impression that the risks of accomplishing objectives through recognized, established channels are excessive, and that the only recourse is to use unofficial, even illegal, means.[30] This particular problem, of course, bears a chicken-and-egg relationship to the larger question of individual responsibility: namely, the elimination of a zero defects mentality is largely a function of the extent to

which individuals are willing to assume responsibility, thereby
rendering themselves less insecure in the face of adversity. The
assumption of such responsibility, in turn, depends equally as
much on the mental adjustment that must be made to accommodate the
unexpected and undesirable.

Just as there are a range of systemic adjustments for dealing with
anomie that can be instituted, so too are there intellectual adjustments that
should be made. First, and most importantly, the distinction must be made
between deviant and merely different behavior--the former being intolerable
in extreme form, the latter being not only permissible but even desirable
from the standpoint of overall institutional viability. Current thinking
within the military, as within other bureaucracies, tends not to make this
distinction. The bureaucratic affinity for uniformity and predictability
makes little allowance for the iconoclast, the maverick, the renegade, or the
occasional weirdo. This affinity manifests itself most clearly in the form
of, again, excessive regulation, which attempts to standardize and routinize
virtually all aspects of military life, from the mundane lacing of boots and
knotting of ties to the more consequential prescription of tour lengths for
commanders and maintenance schedules for vehicles.

It is not illogical to suppose that the military, were it able, would
clone its entire force on individual attributes of the following nature:
alertness, sound judgment, self-confidence, self-control, tactfulness,
loyalty, responsibility, trustworthiness, reliability, emotional stability,
physical fitness, good social adjustment, and good mental attitude. These
particular characteristics, in fact, extracted in the aggregate from Army
Regulations 50-5 (Nuclear Surety) and 50-6 (Chemical Surety) and Army Field
Manual 19-30 (Physical Security), are deemed prerequisite for personnel
serving in physical security and nuclear/chemical duty positions. The fact
that the military cannot guarantee the presence of such characteristics
across the entirety of its force is itself a source of dissonance. Yet, it
is not entirely clear that these particular traits would produce other than
machine-stamped automatons, nor that they would lead to desired organiza-
tional and institutional results.

Interestingly, such qualities as adaptability, creativity, flexibility,
and initiative are not included in the above list. The Army even lists
negligence or delinquency in performance of duty and poor attitude or lack of
motivation as disqualifying factors for its nuclear and chemical Personnel
Reliability Programs. This seems less to reflect demonstrable evidence that
such individuals cannot perform ably than that the Army is unwilling to make
the psychic investment necessary to deal with individualism; T.E. Lawrence's
definition of discipline comes to mind. From the standpoint of efficiency,
this is eminently sensible and justifiable; from the standpoint of crisis
response capacity, it makes far less sense.

The point to be made is that diversity and deviance have markedly
different dimensions and consequences. Tolerance born of insight and under-
standing thus becomes an indispensible element of institutional viability and
of the institution's ability to deal with anomie. The Soviet practice of
declaring dissidents insane and exiling them to the remotest regions of the
Soviet empire is a rightful object of scorn in this country for being an

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example of extreme insecurity bordering on paranoia. We like to think that we would never resort to such measures. But, in so doing, we asssume away the bureaucratic propensity (a propensity not exclusive to the Soviet system) for treating all genre of unconventional behavior as deviance. In the sense used here, deviance represents dissidence--disruptive and destructive behavior that is either volitional or the result of extreme apathy. Individuals who so behave should be expunged from the system, for they represent extreme recalcitrance not worth the cost of recovery. They should, however, be distinguished from those who merely march to the beat of a different drum, who have foresaken conformity for conformity's sake. Philip Slater has made the cogent observation that perfect adaptation produces almost certain obsolescence. Any self-maintaining mechanism must have a certain amount of error built into it, for only imperfect systems, full of self-contradictions, have the capacity to survive.[31] In other words, diversity breeds stability.

Sir James Mackintosh once observed: "Men are never so good or bad as their opinions." Things are rarely entirely black or white. Consequently, a second major intellectual adjustment to be made is to concede that anomie, in contrast to the prevailing pejorative notion of the concept as a catch-all for society's most objectionable aberrations, may well conceal a range of potentially positive, productive human capacities. Creativity, change, and consensus, three more-or-less universal ideals, all may be seen to bear some relationship to anomic behavior. To the extent that this can be shown to be true, it suggests an institutional need to make certain accommodations.

In the famous words of Admiral Lord Fisher, "To be only twenty five percent ahead of one's time results in being regarded as a lunatic." What passes for deviant behavior may, in fact, camouflage incipient, repressed creativity. The dividing line is remarkably fine. Many of the traits commonly associated with the creative personality bear striking resemblances to those found in the anomic person. It has been suggested, for example, that the creative person is attracted to the mysterious, defies convention, is independent in judgment and thinking, has oddities of habit, is discontented, disturbs organization, is a fault-finder, makes mistakes, is stubborn and temperamental, and may even be radical.[32]

Thus, both creative and anomic individuals share certain tendencies. They are dissatisfied, even disgusted, with the status quo. They refuse to conform to accepted social norms. They care little what others think of their "idiosyncracies." They are relatively unconcerned about being punished for their behavior. They are acutely sensitive to the problematical aspects of life, and as a consequence, they experience considerable intellectual (and emotional) turbulence.

According to Erich Fromm, creativeness is a fundamental component of transcendence--man's basic urge to transcend his creatureliness, to go beyond himself and his fate. As one of man's basic psychic needs, transcendence can be achieved in either of two ways: creativeness or destructiveness. The former is the primary potentiality, while the latter is secondary, appearing only when man's inherent urge to fulfill all his potentialities is thwarted.[33]

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The bureaucratic quest for conformity, oftentimes found in its most acute form in the military, is probably the biggest obstacle to creativity. As one author has noted, when an individual is conforming, following, imitating, and being like others, he moves increasingly in the direction of self-alienation. His growth as a creative self is impaired when (1) his involvement in a situation is based on appearances, expectations, or the standards of others; (2) he acts in a conventional manner or according to prescribed roles and functions; and (3) he is concerned with status and approval.[34]

If Fromm's contention (mentioned above) is valid, then this thwarting of creativity by the obsessive encouragement of conformity will eventually push man toward destructiveness. The end-result of such extreme anomic behavior is likely to be the savaging of the military as an institution, through either internal disintegration or ill-timed wartime defeat. It therefore remains the challenge to the military and to society at large to distinguish the innovator from his other anomic counterparts and to exploit his creative potential. John Stuart Mill perhaps put it best when he said: "The amount of eccentricity in a society has generally been proportional to the amount of genius, mental vigour and moral courage it contained. That so few now dare to be eccentric marks the chief danger of our time."

Anomie bears a similar relationship to change, which itself was seen by Durkheim to be the major precipitant of anomic behavior. In point of fact, the link between the two phenomena is inextricable and fundamentally circular in nature. Each time change occurs, there is a disruption of prevailing norms. The more rigid and extensive the change, the more drastic the disruption of norms and the consequent exacerbation of anomic behavior. In turn, as anomie increases, dissatisfaction with the status quo is aggravated, internal systemic stress is heightened, and further change is engendered.

Traditionally in the military, the changes that have been sought (as opposed to those that necessarily have been made) have been incremental in nature. As significant as the changes wrought by technological advances purport to have been, doctrine, force structure, and organizational behavior actually have changed only gradually and marginally in the absolute. In short, the emphasis has been on the maintenance of stability. Ironically, as individuals, Americans seem to value change, irrespective of direction, as an intrinsic good, something to be pursued for its own sake; but, when engaged in collective institutional pursuits, our attitude toward change becomes one of almost intractable resistance. Some critics claim that we have been socialized to seek stability above all else and that, consequently, we are upset by instability and change. It has been suggested that we might just as readily socialize people to instability, so that they will be upset by matters which are too structured and unchanging.[35] Given what most futurists suggest will be the rate and magnitude of change ahead, given the diminishing strategic stature of the United States in world affairs, and given our failure to date to harness technological momentum, this is an appealing approach, if only it can be translated into concrete action.

George Foster argues that four basic conditions must prevail for change to be accepted: (1) The individual concerned must recognize a need and perceive its achievement as possible; that is, it must be a realistic need; (2) the individual must have information on how that need can be met; that is, he must know how to go about achieving his goal; (3) he must have access to whatever materials or services the achievement of his goal requires, and at a cost that he can afford; and (4) his society must not impose excessive negative sanctions on him for innovating; that is, the collectivity of barriers must not be sufficiently strong to dissuade him.[36]

Perhaps the greatest challenge to the military is to provide an environment conducive to such change, to encourage change not for its own sake--something which sedimented inertia and parochialism are likely to preclude anyway--but for maintaining institutional viability amidst environmental flux. In the words of Alvin Toffler, "Ultimately, to manage change we must anticipate it."[37]

The anomic individual holds considerable potential in this regard as an agent of change capable of facilitating effective anticipatory response. Warren Bennis, in arguing that one of the leader's top-priority responsibilities is to ensure that he gets all the valid, undistorted information he needs, contends that the leader must learn to identify and utilize the marginal, borderline "sensors" and "scanners" in the organization--people whose sense of discrepancy enables them to detect variances between the achievements of the organization and its aspirations, people "who have the future in their bones," who (without low-level grumbling and bellyaching) can spot dissatisfaction in themselves and others, and who long for greater achievement.[38] It is the individuals who previously may have been labeled deviants who may provide this capability.

Finally, anomie may be said to relate in a positive, instrumental manner to consensus. Whether as a decision rule or as a participative process, consensus occupies a position of centrality in our society despite the discrepancies that have arisen over time between democratic ideals and practice. It in fact is essential to the character of all institutions, which owe their particular identities to some consensus of values. Douglas Rae has observed: "It is everywhere understood that consensus--this is the way with ideals--has serious practical limits, but these hardly disqualify it from service as a normative criterion to be approximated in experience."[39]

In its essential form, the consensual process involves the adjustment of multiple, independent viewpoints on a given issue to produce a unitary decision that represents the whole. This is no less true nor less important in the military, a reputedly authoritarian, hierarchal institution, than it is in other institutions. The increasing complexity of the decisions facing the military and the pronounced trend toward functional differentiation and narrow specialization make it essential that most decisions be subjected to some type of collective, if not collegial, deliberative process.

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The give-and-take nature of the process requires that some or all parties to a given decision concede or give up something. This may signify willing consent or merely acquiescence. Crozier has spoken of the role that cooperation plays under such circumstances:

> Co-operation means participation in decision-making. The possibility of more co-operative forms of action depends on the attitude of people toward such partici- pation.... It is a partial view indeed which expects people to be always eager for participation. People are very amvibalent toward participation....On the one hand, people would like very much to participate in order to control their own environment. On the other hand, they fear that if and when they partici- pate, their own behavior will be controlled by their coparticipants. It is far easier to preserve one's independence and integrity if one does not partici- pate in decision-making.[40]

In any pluralistic endeavor of even moderate intensity, the acquies- cence of at least some parties to a decision is essential. As the intensity of an issue increases, the more valuable acquiescence becomes. Otherwise, the diversity of interests and opinions may prove enervating and ultimately entropic. Hirschman has spoken of the concept of "slack" in suggesting that, in contrast to the prevailing notion of democracy, which requires the fullest possible participation of all citizens, in reality citizens normally use only a fraction of their resources. A degree of apathy, he notes, has certain compensating advantages, in that it contributes to the stability and flexibility of the political system and provides for "reserves" of political resources which can be called forth in crisis situations. Thus, a mixture of alert and inert citizens, or even an alternation of involvement and withdrawal, actually may serve democracy better than either total permanent activism or total apathy.[41] Consequently, it is logical to conclude that anomic man, because of his inherently acquiescent, even apathetic, nature, may actually be vital to the achievement of consensus. It was Milton who once observed: "They also serve who only stand and wait."

CONCLUSION

In conclusion, anomie is a social phenomenon heretofore largely ignored by the military. Its potential ramifications, if not fully apprec- iated, could weigh heavily on the future viability of the institution. The all-volunteer "experiment" of the past decade has fixed the military's atten- tion on the acquisition and retention of scarce manpower, while leaving precious little time for contemplation of broader dimensions of the civil- military relationship. Surprisingly little thought seems to have been given to broader social and systemic phenomena, particularly to the all- important institutional socialization process by means of which the proto- professional citizen-soldier, who comes to the military with considerable

psychological and emotional baggage in search of an environment that will give structure, if not meaning, to his life, is integrated and assimilated into his new subculture.

In the rush to attract personnel, the military, like other organizations and institutions, has been especially enamored (at least in principle) with the idea of self-actualization.[42] A common misperception, however, has been that the enrichment of human values can only be achieved by granting maximum latitude to institutional members to do their own thing, rather than by creating a normatively robust learning environment in which each individual is challenged and expected to achieve his ultimate potentialities. This has led to an acute dissonance--the military thinking it can only achieve its objectives by compromising cherished standards; large segments of the soldiery thinking they have been cut adrift by an institution unable to find itself. The result has been a hothouse effect in which the conditions that permit anomic behavior to thrive and grow have been fed.

Ironically, the anomic individual is unlikely to feel a need to self-actualize or to fulfill other than modest ambitions. If anything, he probably is more-or-less ambitionless; thus, he will express little drive, self-motivation, or competitive spirit. What innate talents, including creativity, he may possess, will have to be drawn out. To the extent that this alleviates internal conflict, it is probably good. But, if left unattended, it can mutate into less controllable forms of disruptive and destructive behavior. To the extent that this creates extraordinary demands on leaders, the situation is bad, for the military is possessed of the same "zero defects" mentality that afflicts other sectors of society. Consequently, there is little time for leaders to experiment with behavior, to deal with individuals as individuals, or to allow (much less encourage) unconventional behavior.

A partial solution to the problem is for the military to institute a range of both systemic and intellectual adjustments designed to deal with the effects of anomie. Systemically, the military should seek to de-regulate, to rationalize its established policies and programs, and to accept competence as an ethical imperative. Intellectually, the distinction between diversity and deviance must be recognized and dealt with, and the potential contributions of anomic behavior to creativity, change, and consensus acknowledged. Only in this manner can the military hope to achieve the sort of institutional vitality and enduring legitimacy that will carry it into the 21st century.

NOTES

1. Edward A. Shils and Morris Janowitz, "Cohesion and Disintegration in the German Wehrmacht in World War II," Public Opinion Quarterly, 1948, 12, pp. 280-315.

2. See Paul L. Savage and Richard A. Gabriel, "Cohesion and Disintegration in the American Army: An Alternative Perspective," Armed Forces and Society, May 1976, pp. 340-376; Richard A. Gabriel and Paul L. Savage, Crisis in Command: Mismanagement in the Army, New York: Hill and Wang, 1978; and Richard A. Gabriel, "Combat Cohesion in Soviet and American Military Units," Parameters, 1978, VIII, pp. 16-27.

3. See, most notably, Daniel W. Jacobowitz, "Alienation, Anomie, and Combat Effectiveness," Air University Review, September-October 1980, pp. 21-34; Stephen D. Wesbrook, "Sociopolitcal Alienation and Military Efficiency," Armed Forces and Society, Winter 1980; and Wesbrook, "The Alienated Soldier: Legacy of Our Society," Army, December 1979.

4. Nonetheless, it is important to recognize, as most of the literature has, that the two concepts are inextricably linked, complementary, and seemingly mutually reinforcing. Thus, the line of demarcation is quite fuzzy.

5. Emile Durkheim, Suicide (1897), translated by John A. Spaulding and George Simpson, New York: The Free Press, 1951.

6. Quoted in B. H. Stoodley, Society and Self, New York: The Free Press, 1962, p. 235.

7. Ibid., p. 235.

8. Charles Hampden-Turner, Radical Man, Garden City, NY: Anchor Books, 1971, p. 79.

9. J. Horton, "Order and Conflict Theories of Social Problems as Competing Ideologies," The American Journal of Sociology, May 1966, pp. 701-713.

10. Robert M. MacIver, The Ramparts We Guard, New York: Macmillan, 1950, p. 84.

11. Herbert McClosky and John H. Schaar, "Psychological Dimensions of Anomy," American Sociological Review, 1965, 30, pp. 14-40.

12. Bruce P. Dohrenwend, "Egoism, Altruism, Anomie, and Fatalism: A Conceptual Analysis of Durkheim's Types," American Sociological Review, 1959, 24, pp. 466-473.

13. Gabriel Almond, Comparative Politics: A Developmental Approach, Boston: Little, Brown, and Company, 1966, pp. 75-76.

14. Ted Robert Gurr, Why Men Rebel, Princeton, NJ: Princeton University Press, 1970, p. 134. Also, see Sebastian de Grazia, The Political Community: A Study of Anomie, Chicago: University of Chicago Press, 1948.

15.   Mark N. Hagopian, <u>The Phenomenon of Revolution</u>, New York: Dodd, Mead, &
       Co., 1974, p. 132.

16.   Peter Berger, <u>The Sacred Canopy</u>, Garden City, NJ: Anchor Books, 1976,
       p. 22.

17.   The term "panchreston" was coined by G. Hardin, "Meaningless of the Word
       Protoplasm," <u>Scientific Monthly</u>, 1956, 82, pp. 112-120.   It has been used
       effectively by Frank Johnson in dealing with the concept of alienation:
       Frank Johnson, ed., <u>Alienation: Concept, Term, and Meanings</u>, New York:
       Seminar Press, 1973, pp. 3-4.

18.   McClosky and Schaar, <u>op.cit.</u>

19.   Durkheim, <u>op.cit.</u>

20.   Robert K. Merton, "Social Structure and Anomie," in Hendrik M. Ruitenbeek,
       ed., <u>Varieties of Modern Social Theory</u>, New York: E. P. Dutton, 1963, pp.
       364-401.   For a more extended discussion, see Merton's <u>Social Theory and
       Social Structure</u>, Glencoe, IL: The Free Press, 1959.

21.   Lewis Rhodes ("Anomie, Aspiration, and Status," <u>Social Forces</u>, 1964, 42,
       pp. 434-440) has suggested that anomie is maximized where distance between
       aspirations and life chances for success is maximized <u>in both directions</u>,
       i.e., where aspiration is high and status, hence life chances for success,
       is low, and conversely where aspiration is low and status high.

22.   Leo J. Srole, "Social Integration and Certain Corollaries: An Exploratory
       Study," <u>American Sociological Review</u>, December 1956, pp. 709-716.

23.   Dorothy L. Meier and Wendell Bell, "Anomia and Differential Access to the
       Achievement of Life Goals," <u>American Sociological Review</u>, 1959, 24, pp.
       189-202.

24.   McClosky and Schaar, <u>op.cit.</u>

25.   See Richard M. Jennings, "The Military and Social Adaptation," <u>Strategic
       Review</u>, Winter 1976, pp. 72-78.

26.   Avoidance is an equally acceptable variant, but only in the form of preven-
       tive measures, not in the form of institutional acquiescence or capitulation.

27.   It must be noted that Durkheim actually distinguished anomie from
       fatalism on the grounds that the former is a state of de-regulation
       and declassification, while the latter is the direct opposite, a
       state of excessive regulation in which futures are pitilessly blocked
       and passions violently choked by oppressive discipline (Dohrenwend,
       <u>op.cit.</u>).   With due respect to Professor Durkheim, whose formulation
       of the concept of anomie entitled him to define it as he saw fit, it
       seems questionable that this distinction is as meaningful as it was

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27.   intended to be. In the present context, excessive institutional
        regulation is seen as contributing to individual de-regulation,
        creating an impression (perhaps self-serving)in the mind of the
        individual that the institution will decide everything for him,
        thus absolving him of responsibility for formulating and maintain-
        ing personal standards of behavior.

28.   N.F. Dixon, On the Psychology of Military Incompetence, London:
        Jonathan Cape, 1976.

29.   Lewis Sorley, "Competence as Ethical Imperative: Issues of Profes-
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Utility Considerations in
Emotional Stability Monitoring for Nuclear Plant Personnel

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Biographical Sketch

Dr. Sandra L. Davis is co-founder and principal of MDA Consulting Group, Inc. In this Minneapolis-based firm Dr. Davis is involved in industrial psychology applied to organizational and individual development. She has expertise in selection, performance appraisal, assessment, team building, training, and behavioral reliability.

She graduated from the University of Minnesota in 1973 with a Ph.D. in Counseling Psychology. After serving in the faculty of the University of Minnesota she joined Personnel Decisions, Inc. in 1977. In late 1981 she and a colleague (Dr. Pierre Meyer) formed MDA Consulting Group, Inc. She has considerable experience in personnel security issues through her work in employee screening in the nuclear industry and her work for the Nuclear Regulatory Commission on behavioral reliability programs for ongoing monitoring of emotional stability and trustworthiness.

Utility Considerations in
Emotional Stability Monitoring for Nuclear Plant Personnel

This paper presents a system for ensuring the continued reliability
of personnel operating in a security sensitive environment. The con-
cepts flow from two related research efforts. The first was conducted
by Personnel Decisions Research Institute for the Edison Electric Insti-
tute, an industry association representing approximately 200 investor-
owned utilities. As one element in developing an empirically validated
selection system for use with the operator position in electric gener-
ating plants, PDRI identified dimensions of emotional stability for
nuclear plant operators.

The second research effort was conducted for the Nuclear Regulatory
Commission. The objectives of that one year effort (in which the author
was project co-manager) were to determine the feasibility of a behavior
observation program, to create a model program, and to set standards
for the program's implementation. Finally, the author's experience
in helping to establish a behavioral reliability program with several
different nuclear utilities has provided a sharp picture of what con-
tributes to a program's effectiveness or ineffectiveness.

This paper does not attempt to prove or to argue the importance of
behavioral reliability of personnel in maintaining physical security.
However, given that physical security is linked to the reliable judg-
ment of personnel, given that potential employees can be screened for
"reliability" (emotional stability and trustworthiness), and given
that human behavior is dynamic and changes over time, then ongoing
monitoring to ensure continued reliability in employees is necessary.

The Components of a Behavioral Reliability Program

A behavioral reliability program encompasses several interlocking com-
ponents. Each component contributes to the program's effectiveness
in accomplishing its goals. The four components are shown schematically
in Figure 1.

A behavioral reliability program also exists within an organization's
total system for ensuring employee reliability and enhancing the phys-
ical security of the facility. For example, the program must overlap
and correlate with pre-employment screening practices. This can be
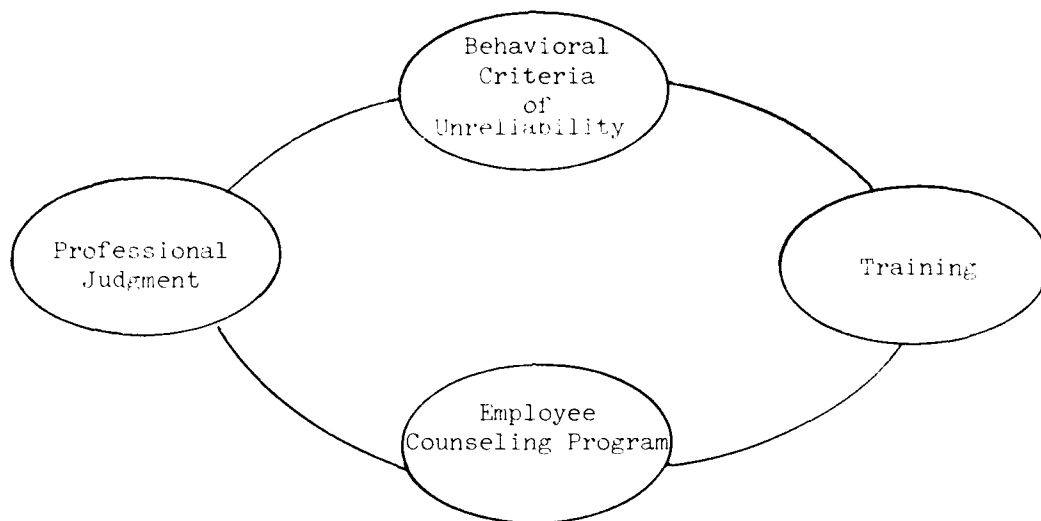shown schematically as in Figure 2.

Figure 1
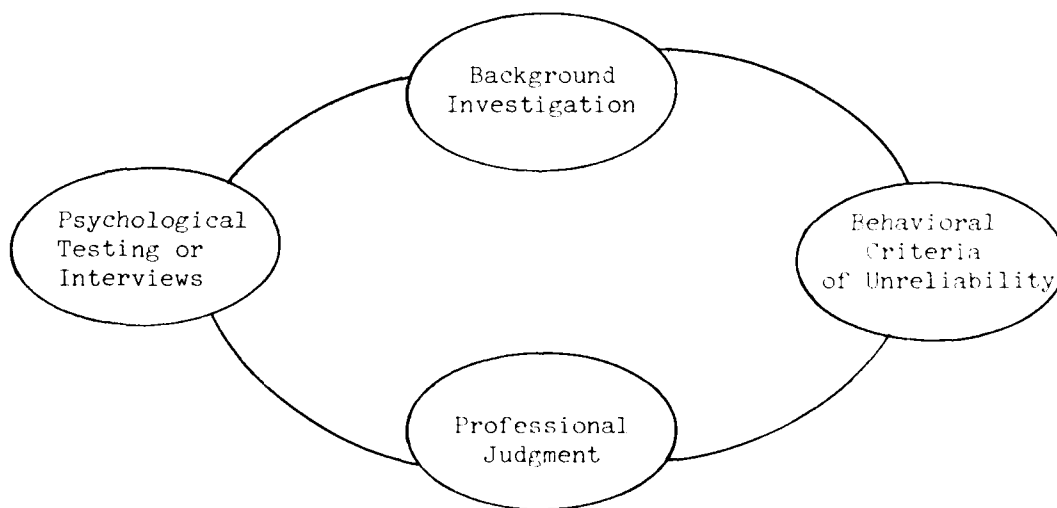Components of a Behavioral Reliability Program

Figure 2
Components of an Employee Screening Program

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These two schematics illustrate the need for compatibility and consistency between screening systems and a behavioral reliability program. In short, the criteria used to screen an individual in or out must be the same as the criteria used to decertify an individual or to remove his/her access authorization. Also, the professionals (often psychologists or psychiatrists) who determine initial access should also evaluate continued access.

The next few sections outline in more detail each of the four components of a behavioral reliability program.

Behavioral Criteria of Unreliability. Government agencies, police and fire departments and utilities have wrestled with this issue. What are derogatory criteria? What is meant by emotional stability? What is meant by lack of trustworthiness? Few guidelines exist, psychologists would be unable to reach concensus on these questions, and established standards are vague. Most guidelines are in the form of "individuals with aberrant behavior patterns should be screened out." The difficult questions become even more intricate as one moves from the arena of screening decisions to decertification decisions. Most of the military personnel reliability programs could be subsumed under the heading of "if you notice anything abnormal, report it."

In the study conducted by Dr. Marvin Dunnette and Personnel Decisions Research Institute, the underlying dimensions of "emotional stability" were identified. In critical incident workshops representatives of 25 nuclear-owning companies generated examples of specific situations which had occurred with operating personnel. Behaviorally-anchored, five-point scales were developed for each of the resulting 18 dimensions. Following a further factor and cluster analysis of the dimensions, five strong consistent factors emerged.

These factors of behavioral unreliability include: 1) Argumentative hostility toward authority; 2) Irresponsibility/carelessness; 3) Defensive incompetence; 4) Psychopathology; and 5) Reaction to stress. This last factor is potentially associated with problems with alcohol or other drugs. In fact, chemical dependency with no proof of successful treatment is frequently involved in a decision to screen someone out of employment at a nuclear site.

Next, groups of personality testing experts were convened to discuss and interpret dimensions and to select tests or scales on tests likely to be helpful in identifying high scorers on the dimensions. The experts agreed that a test like the Minnesota Multiphasic Personality Inventory would measure factors 1, 4, and 5 (chemical dependency only) well and that an instrument like the California Psychological Inventory (CPI) or the 16PF (16 Personality Factors) would measure 1, 2, and

4. Further, since tests raise hypotheses about an individual and can lead to false negatives or false positives, if the instruments are used in screening they should be followed by a clinical interview by a qualified professional to confirm or further clarify the test scores.

These factors of behavioral unreliability most likely generalize to other jobs in the nuclear plant and other work settings. Most of the behavioral examples written in the initial workshops dealt with fairly common kinds of personality clashes in power plants. The same kinds of emotional/behavioral stability problems occur in manufacturing plants, in business in general, in police and fire departments, in the military and most likely in any work environment. However, in some work environments the cost of behavioral unreliability on the job could be enormous in true dollars or in human lives or in security breaches.

The major problems faced by power plant supervisors are operating people who are hard to get along with (and, hence, don't contribute effectively to an operating team) and operating people who don't tolerate the routine and relative boredom of a steady state operation. These latter people either generate their own stimulation, or daydream and escape internally. Generating their own stimulation may lead to horseplay, sabotage, theft, and trying to beat various plant systems. Daydreaming can lead to overlooking important information or indicators of plant status.

Psychopathology is rare in the population in general. Further due to self-selection, screening procedures, observation during training and probation, psychopathology is far rarer in power plants. Incidence would be higher in work environments where few or no screening procedures exist. The potential costs of psychopathology playing a role in poor decisions on the job are very high despite a very low incidence. Therefore, a continuing effort is necessary to identify and remove emotionally/behaviorally unreliable people at entry level and continuously throughout their careers.

How might these factors be used in a decision to decertify or to revoke access authorization? Suppose a supervisor or superior notices signs of behavioral change or a continuing series of judgment errors in an individual employee. The employee can be referred through a series of steps to a psychologist or psychiatrist who can test, interview, and evaluate the individual against the criteria. That individual can also consider the reports of on-the-job behavior as they relate to the criteria. The tests and the clinical interview should be identical to the ones used in the pre-employment screening process.

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Professional Judgment. This brings us to another essential component of both screening and monitoring decisions about emotional/behavioral unreliability. A layperson (manager, commander, supervisor or even personnel officer) is not qualified to interpret accurately such sensitive tests as the MMPI, CPI, or 16PF. Further, a layperson is not trained to conduct a clinical interview and evaluate the results in light of the criteria and the test profiles. If screening on emotional stability/behavioral unreliability is desired, then it is mandatory that an expert in this area be involved.

During our research for the NRC, we visited numerous utilities across the country. The "screening" for emotional stability took many forms from superficial and ineffective to thorough and careful. Contrast a set of five questions asked by a physician with an elaborate testing procedure using the MMPI and CPI, a clinical interview with a Ph.D. psychologist, and a review of the judgment with a second psychologist. Not surprisingly in the former example no one had ever been screened out. In the latter example approximately 40 percent of all applicants were interviewed, 5 percent across all job categories were screened out, and approximately 10 percent of all applicants for "high risk" jobs were screened out.

Computerized interpretations of personality inventories still require a judgment on someone's part about whether an individual should be certified or have access. Labeling an individual has high, low, or medium risk sounds appealing on paper, but what does it mean and who knows if it is accurate? If an individual is identified as "low risk," as decision makers we may be lulled into a false sense of security. If an individual is identified as "high risk" by the computer's inter- pretation, as decision makers we may decide against someone unfairly.

Therefore, a professional such as a psychologist or psychiatrist needs to be involved in evaluating an individual's tests or the conducting the interview or designing what system to use. I offer as standards of the choice of professional the following ideal criteria set forth in the NRC document 10CFR 5076 (Section 6.2.4).

The role of the professional in ongoing monitoring is equally vital. Supervisors and superiors should not be required or expected to judge their subordinates' emotional stability or to rule on their continued certification. This is not to imply they have no role or responsibility in the continued reliability of their subordinates. Their role is critical and central as we will see in the next section.

Training. As the NRC work unfolded, two things became clear. One is the importance of screening procedures and background investigations to eliminate potentially unreliable individuals from jobs in a work

environment in which security is important. The second is that employees, once screened in, must continue to be monitored for behavioral unreliability. Once again, expert panels were convened to discuss how behavioral unreliability might be manifested on the job, not only in incidents of questionable performance but also in behavioral signs prior to extreme incidents occurring. In short, we wanted an "early warning" system. Once the listing of behaviors and most importantly, behavioral changes was completed, we asked who in the work environment could and should monitor employees. The best resource is peers if work peers can be convinced to report on each other. (This may be a more viable option in a highly controlled environment such as the military.) However, our experts eliminated peers as a realistic source of information in the nuclear setting. The unanimous choice was the supervisor. Safety, supervision, observation, evaluation, and appraisal are already integral parts of their job responsibilities.

We designed a training program to help supervisors learn their roles, learn the specifics of "early warning" in relation to behavioral unreliability, and learn steps they can take in several typical kinds of situations. These situations include disciplinary problems, immediate risks (when an individual needs to be escorted off site), and potential troubled employee problems.

The training included skill building in behavior observation, in confronting individual employees effectively, and in making judgments about action steps to be followed. A key to supervisors being willing to take action is their belief that the individuals they may identify will be helped and not just judged and labeled.

Employee Assistance Program. For an early warning system in behavioral unreliability to work effectively, it must be non-punitive. The resource is a company-sponsored counseling program. Most cases of behavioral unreliability on the job are triggered by situational stress, life changes, or traumatic events in an individual's life. By obtaining professional assistance and counseling support, an individual can learn to cope or to deal with his problems. Supervisors can refer or, as in programs which have existed for some time and are credible, many employees will refer themselves or their family members. In a sense these programs encourage employees to be responsible for themselves. Some police departments use a system very effectively which allows an officer to opt out of "street duty" or other high stress assignments for one to several weeks with no loss in pay, rank, or promotional consideration.

Conclusions. The most effective behavioral reliability programs include all four elements: Some data exists which show more acts of sabotage, theft, or vandalism occur in environments in which screening hurdles

are minimal and other security precautions are minimal. A behavioral
reliability program must include training in observation skills for
the individuals charged with the responsibility of ensuring reliability
of their subordinates. It must be linked with a screening program
through definition of criteria and the judgment of a professional psy-
chologist or psychiatrist who knows the job environment. Finally,
it must provide resources for the employee or individual who, once
screened in, is now denied access.

COGNITIVE COMPLEXITY AND TASK DEMAND

AS JOINT INDICATORS OF BEHAVIORAL RELIABILITY

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INTRODUCTION

As unsettling as it may sound, departures from behavioral reliability occur rather frequently in high stress jobs. When they occur, they are often associated with degradation in overall job performance, and even more important, with reduction in effectiveness in emergency responses (Cooper-Payne, 1978). The risk of incidents exhibiting departures from behavioral reliability would theoretically be high in the nuclear industry. This is due to the fact that high levels of stress associated with certain critical activities will increase the potential for emotional instability, a probable indicator of future unreliability-based behavioral incidents (Swain, 1974).

Based on these findings, and on the general perception that typical selection screening is not, by itself, sufficient to minimize such incidents, several government agencies and industries have developed programs which, "on a continuing basis," assess the emotional stability of personnel in sensitive jobs (Purdue University, 1975). Examples of these types of programs range from DOD Regulations AR50-5/6 and the American National Standards Institute Standard 18.17 to NRC's NUREG CR-2076, which provides overall guidance for the development and implementation of a behavioral reliability program. All of these procedures operate under the following generic assumptions:

o Departures from behavioral reliability (aberrant behaviors) are not uncommon and may be indicative of decrements in performance quality which could effect the safety and security of the facility.

o The relationships between indicators of aberrant behavior and the severity of resulting performance decrements (if any) are not clearly understood.

o Several varieties of behavioral observation programs exist but none have demonstrated the required levels of validity and reliability necessary for the nuclear industry.

The Threat

Fortunately, destructive acts aimed at the nuclear industry by outside malevolent groups have generally involved vandalism, minor theft and pranks. For the most part, political extremists and single issue ad hoc groups have not attacked nuclear facilities nor gained possession of special nuclear material (SNM). It is also comforting to note that organized crime has, to date, found little interest in nuclear facilities since immediate financial gains are not highly probable. For the moment then, these groups do not appear to pose the primary threat to the nuclear industry. However, as anti-nuclear forces become more organized and terrorist groups share more information, material, and training, this threat may become more potent (Pilgrim, et al., 1981).

A major threat to today's nuclear industry is the so-called "insider," i.e., the present or former employee. This threat may be manifested in several ways, e.g., the disgruntled employee, the chemically dependent employee, the employee with financial problems, and the "bright" employee who attempts to prove that there are "holes" in the system (Buchanan et al., 1981).

There is also the problem of voluntary collusion, i.e., cooperation with some outsider who is interested in gaining access to SNM. Involuntary collusion is more insidious, but just as dangerous. A typical scenario involves an employee bending the rules (for example, confirming an unchecked supply list) for a presumably honest associate. When or if he/she realizes fraud is involved, continued cover up is required because the employee's own job is now jeopardized. Loyalty to one's associates and immediate supervisor is another, perhaps related, reason that employees may not choose to report illegal or fraudulent activities.

Analysis of Behavioral Reliability

In previous efforts we have analyzed behavioral reliability into four classes of behavior including error-proneness (can he do the job), emotional stability, propensity toward compromise (is he secure), and criminal activities (is he honest). Regardless of the underlying causes, the issue of behavioral reliability always reduces to the question, "will the employee perform his duties accurately and completely, time after time and from location to location?". The interrelationships among these four classes of behavior are illustrated in Figure 1.

The first category concerns the relationship between the requirements of the job and the knowledge, skills, and abilities of the potential employee. If the requirements are met, the employer may assume that the selectee can do the job.

The other three categories are mainly concerned with issues which bear on whether or not he will do the job. It is these categories which are the main concern of a behavioral observation program. The first of these categories of behavioral indicators relates to the emotional stability of the potential employee.

Such questions as:

o   "Will he go off the deep end over some small provocation?"

o   "Will he be so preoccupied with neurotic fears that he
     overlooks important aspects of his job?"

o   "Does his use of alcohol or drugs interfere with his
     judgment on the job?"

comprise a necessary and proper approach toward this first filter in selection and monitoring of personnel performance.
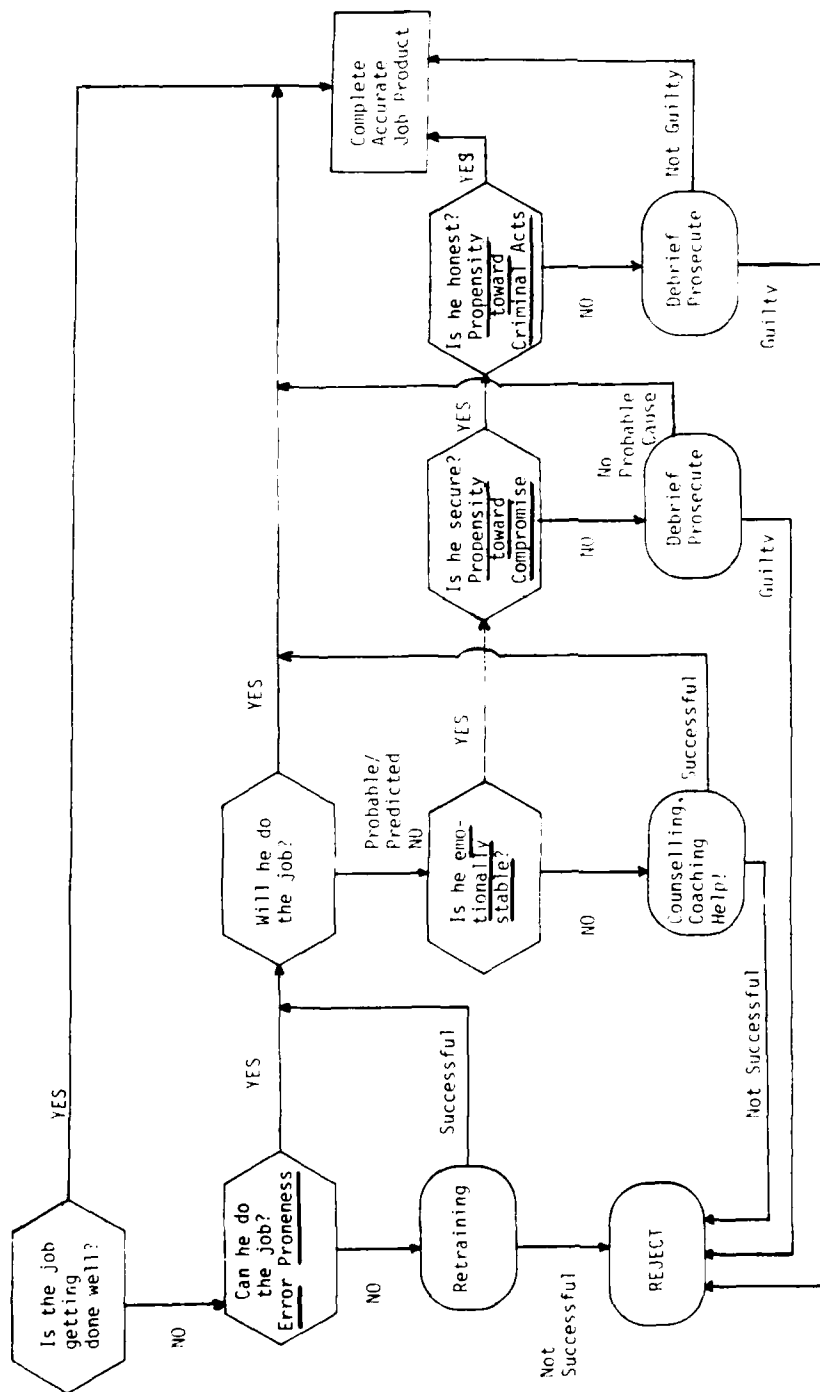
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Figure 1. Interrelationship among the categories of human reliability

The next category of behaviors relates to the employee's probability of compromise with a foreign power or adversary group. Questions regarding the employee's affiliation with fringe groups or with politico/terrorist groups will provide useful information. In addition, indications of fanatic support of some cause would also provide useful data.

The third class of behaviors relates to an employee's willingness to perform anti-social, criminal, or vindictive acts. Answers to questions such as "will the employee sell information or nuclear material to criminal elements for profit or revenge?" could provide indicators of anti-social potential.

Current Programs

One telling criticism of present behavioral observation programs is the lack of inter-rater reliability due to an inadequate definition of the behaviors to be measured and due to a lack of specificity about how often and under what circumstances observers should report.

Another major problem is that no major body of research data typically exists to demonstrate the effectiveness or ineffectiveness of a program in operation. In essence, programs often operate under the assumption that if they were not being done, substantial problems of employee reliability could occur. Certainly no one is willing to conduct a truly experimental study in a sensitive setting to find out whether employees who are known terrorists are more likely to create accidents or commit acts of sabotage or theft than other groups. However, some type of formative evaluation must accompany any new behavioral reliability program.

In the more pragmatic areas regarding reliability program implementation, several problems exist. These include: cost of training, both initial and on-going; time taken away from other job duties; and supervisors' dissatisfaction with having more job responsibilities added to their work load. These issues, together with the fact that most of the programs we have surveyed did not clearly define administrative decision making or procedures to be followed, detract from their effectiveness.

The solution to this problem rests on the development and implementation of a valid and feasible cost-effective method of measuring overall behavioral reliability. This method must include a tool or tools and some systematic approach to implementation both for initial selection and for on-going measurement of behavioral reliability.

Several approaches to this problem have been attempted in the recent past. These approaches include clinical evaluation of psychological welfare, attempts to pinpoint specific indicators of emotional stability and more behaviorally oriented approaches to continuous observation of job performance.

Each of these approaches may succeed in identifying some indicators of emotional stability which, in the aggregate, will be correlated with low levels of performance reliability. However, the immediate problem is to select and

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maintain high levels of reliability on an individual basis. This is especially true in light of proposed NRC rulemaking requiring periodic certification of critical individuals as fit for duty. Therefore, a more global measure should be explored that will account for the categories of behavioral reliability mentioned before. This measure could be based on the interaction between an individual's cognitive style and the cognitive demands of his job.

Cognitive Complexity

Recent efforts in the area of cognitive psychology have begun to focus theory and research on the topic of structure (as opposed to content) of behavior. That is, these efforts have been designed to investigate "how" people think, rather than "what" is the content of the thought. A popular approach to this area has emphasized the dimensionality of human information processing as a theoretical focus. Such efforts have been termed "Complexity Theories" (Streufert, 1982).

Since the inception of this viewpoint (Bieri, 1955), theoretical progress has moved from an emphasis upon differentiation (i.e., the number of separate judgments made in response to a stimulus configuration), through integration (i.e., Harvey, Hunt, and Schroder, 1961) where the thrust is upon the combination of judgments in a complex environment, to the current interactive approach (e.g., Streufert and Streufert, 1978), which postulates an interactive effect between environmental conditions and behavioral style.

Recent work in interactive complexity theory has postulated that as the environmental complexity of a situation increases, a person's ability to demonstrate flexible differentiative and integrative performance in complex decision-making tasks follows a series of inverted U-shaped curves.

According to Streufert (1982), the potential for multidimensional (differentiative/integrative) behavior is considered to be optimal at some intermediate level of environmental load. However, differential maximum elevations of the U-shaped curves at that optimal point reflect differential styles of information processing. That is, interactive complexity theory postulates the existence of various styles of information processing. Current theory specifies nine such styles (Streufert and Swezey, 1982). Individuals employing such styles presumably show differently constructed inverted U-shaped curves (c.f. Figure 2). The nine categories are described below.

Category 1: The low unidimensional decision maker. On the average, this person uses a categorical (e.g., good vs. bad) judgment in response to a stimulus. Degrees of judgment (e.g., A is better than B, but not as good as C) are rarely, or never, available. The dimension utilized is usually the same with regard to nearly all stimulus situations, but could occasionally vary with the domain employed.

Category 2: The normal unidimensional decision maker. This person utilizes a single dimension in response to any particular stimulus, but can also consider "shades of gray" (i.e., discrimination of points along one dimension). If
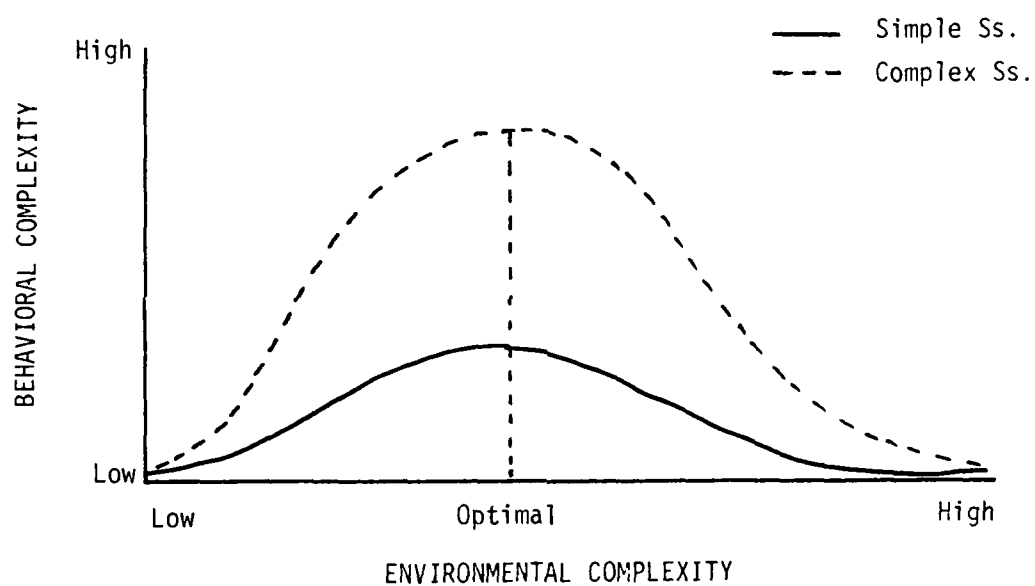
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Figure 2. Degree of flexible differentiation and integration in perception and performance as a function of environmental complexity (Revised theory: Streufert and Streufert, 1978)

different dimensions are employed for different stimulus situations, the person is probably not aware that he or she is utilizing different dimensional judgments (e.g., utility in a business stimulus setting; good vs. bad in a religious setting, etc.).

Category 3: The general differentiator. This person does (with awareness) employ two or more dimensions in response to a single stimulus (or stimulus set), but either views these dimensions as non-interrelated (e.g., a person is like this when A happens and like that when B happens), or would pick and choose one of the dimensional outcomes for his or her actions. In other words, integration does not take place except in extremely limited situations.

Category 4: The closed-hierarchial-differentiator. Here, the effect of closedness is combined with the process of hierarchial information processing (the absence of processing flexibility). While the processes involved are oblique, they are not necessarily so widely separated in the decision-making process to justify independent categories. Hierarchial processing of information form input to output (perception to decision making) suggests that a set of relationships has been learned, or is otherwise given, that determines the outcome in advance. For example, the process may say "if event A occurs, it may be responded to by either X or Y. Which of the two is appropriate depends on the simultaneous occurrence or nonoccurrence of B."

Closedness indicates that the pre-learned process is not, in and of itself, subject to modification. Relearning of a new process would have to follow the same pattern of learning that was established when the initial acquisition took place, or would at least, require major (probably negative reinforcement) impact experiences.

The closed hierarchial differentiator, then, employs two or more dimensions in response to a single stimulus: dimensions that are predetermined and that have predetermined characteristics or rules governing which dimensions are selected.

Category 5: The excessive differentiator. Differentiation into finer and finer sub-dimensions can take place nearly ad infinitum. Some decision makers tend to generate an inordinate number of alternative possibilities of responding, consequently responding very late or not responding at all. Integration does not take place at all for such persons.

Category 6: The low level integrator. Developing beyond the general differentiator, the low level integrator is able to close (for decision making) and reopen (for reconsideration or for additional decision processes). Such a person will differentiate incoming information, i.e., view a stimulus on more than one dimension, as the differentiator did, but will see no need to make a decision choice based on only one of these dimensions. Rather, some superordinate concept (dimension, etc.) may be used to combine outcomes from the two separate dimensional judgments into a single decision output (or several related outputs).

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Category 7: The high level integrator. As in Category 6, flexibility to be open, to close, and to reopen is again given. The difference here is the number and interactive characteristics of the superordinate concepts that are used to relate the different "readings" from the various dimensions on which a stimulus is perceived.

Category 8: The closed hierarchial integrator. Again, we are combining closedness with hierarchial functioning (for the reasons listed earlier). Here, the decision maker has learned (or has otherwise determined) specific complex conditional statements in response to specific relationship between stimuli and decision outputs. He is using a (often weighted) complex branching technique to arrive at a fixed decision. He is not likely to reopen to reconsider his decisions or to alter his style in the face of input that does not quite fit preestablished patterns. Most likely such an input would be distorted to fit. Changes in the dimensional location of certain stimuli are likely to be rejected, particularly if they require a modification of several relationships in the hierarchial structure of conceptual relationships.

Category 9: The non-closing integrator. This person is simultaneously quite capable, yet decisively ineffective. The non-closing integrator is usually a flexible integrator with high level integrative capacity (c.f., Category 7), but without the ability to close temporarily for decision making. This is a person who generates an inordinate number of complex interpretations and decision potentials, taking a large number of concerns into account. Because he or she comes to so many different conclusions, none of which seem quite good enough (because there are still so many other things to consider and integrate), decisions will rarely be made. If they are made, they tend to span over long time periods (on the average).

Complexity theory has been tested in basic laboratory experiments (e.g., Streufert, 1966), in organizational manned simulations (e.g., Streufert, 1970), and in a large number of real-world settings (summarized in Streufert and Streufert, 1978). The predictions of the theory have been confirmed for perceptual (e.g., Streufert and Driver, 1965), and complex decision-making tasks (e.g., Streufert and Schroder, 1965) among others.

As an example of work in this area, it has been shown that high level executives are more successful if they are multidimensional integrators (particularly if they are involved in long range planning tasks), that the degree of differentiative and integrative complexity of political speeches by national decision makers foreshadows war and peace (Suedfeld, Tetlock, and Ramirez, 1977) and that the complexity of political/military leaders predicts whether they will stay in power when a period of strife is replaced by a more tranquil political environment (Suedfeld and Rank, 1976).

On the basis of such data, one might be tempted to consider complexity as a continuum wherein "more is better," as is the case (for example) with intelligence. (Parenthetically, complexity appears not to be correlated with IQ). Such is not the case.

In fact, there are many tasks where the development of strategic, or planning (i.e., integrative information processing) activities, are highly desirable, and others where they are most definitely not. If, for example, a security guard is sitting at a computerized CCTV console which depicts an incoming intruder signal and the computer identifies that blip on the screen as an error since its speed and vector do not match any capabilities the threat is known to have, the decision maker may be better off pushing the button which would activate the defense against the potential intruder. Considering the various alternative interpretations of the computer display in differentiative and integrative fashions may be quite inappropriate. Certainly if the supposed intruder turns out to be an animal, the incurred loss due to defensive action would not likely be severe. If, on the other hand, the threat has developed a new attack mode which is as yet unknown to our security manager and to his computer program, life and equipment may have been lost because of excessive cognitive activity. A simple respondent decision upon receipt of the information would have been more appropriate (c.f. Streufert, 1982).

It has been pointed out that it is not always appropriate to differentiate and/or integrate. Further, it is not always easy to engage in much differentiative and/or integrative activity when the environment is not at all conducive to complex information processing. Last, but not least, there clearly are differences among the information processing styles of persons: some, assuming conditions are optimal, tend to engage in considerable differentiative and integrative cognitive activity; others do not.

How can our knowledge about incidence, characteristics and appropriateness of cognitive differentiation and integration be applied toward behavioral reliability? First of all, we should realize that cognitive complexity is not a cure-all. Clearly, persons who can respond with a more complex (differentiative and integrative) style would not outperform others when the task requirements themselves are rather simple. On the other hand, we know that differentiative and integrative complexity is extremely useful when task requirements are appropriate. Secondly, we can expect differences (where appropriate) only if the environment is somewhat optimal in its level of stressors. We might consider that cognitive complexity will likely be a valuable applied concept in behavioral reliability analysis if we can identify the relationships between complexity, risk-taking behaviors and behavioral reliability. Current research is underway in this area, and it has recently been shown that both diastolic arousal and information load moderate risk-taking behavior in complex tasks (Streufert, Streufert, and Denson, 1982). Further, efforts are underway to relate cognitive complexity with load, risk-taking and decision-making performance in a series of complex politico-military simulations (Swezey and Unger, forthcoming). To the extent that such efforts prove successful (and they appear to hold considerable promise), they may well pave the way toward a cognitive complexity/risk-taking approach to the investigation of behavioral reliability.

The Approach

Based upon the cognitive complexity literature, given the existence of serious behavioral reliability problems, it appears appropriate to investigate this area as follows:

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o Operationally define and measure both behavioral
   reliability and cognitive style.

o Empirically explore the relationship between
   behavioral reliability and cognitive style as a
   function of task demand.

We propose to operationally define behavioral reliability as a function of the
numbers of appropriate decisions made within the context of job task simulation
scenarios. In order to empirically explore the relationships mentioned above,
we are now in the process of developing a microcomputer-based, decision assess-
ment simulation which can be readily adapted to this requirement.

As defined before, behavioral reliability essentially boils down to one
major issue: to what degree can we predict the behavior of an individual in a
critical situation. One approach to measuring this reliability can be accom-
plished by providing a variety of interrelated scenarios, derived directly from
job content, which portray critical aspects of the job. Each scenario will pro-
vide the setting, situation, and consequences; and will allow for numerous
decision alternatives, including asking for more information. We are currently
developing a scenario for each of the four categories of behavioral reliability
discussed previously, i.e., error proneness, emotional stability, propensity for
compromise, and criminal activity. These mini-scenarios will then be interwoven
into one full-scale scenario for use in the empirical investigation. This
scenario will serve as the context in which the decision validity will be
assessed, along with cognitive complexity as measured by various existing instru-
ments and devices. (See, for example, Bieri et al., 1966; Streufert and
Streufert, 1978; and Streufert and Swezey, 1982.) The resulting data will be
used to construct a cognitive profile for comparison with an individual's
decision appropriateness (i.e., behavioral reliability).

We will also seek to manipulate job task demand. This variable is mani-
pulated by changing the information presentation rate for the scenario. For
example, a scenario could be run slowly to simulate the task demand of a
security guard during normal duty or speeded up via compressed time to represent
task demands during an unauthorized access. The duration of the scenario is
actually subject dependent since decision time and numbers of decisions are
subject-controlled variables. Therefore, task complexity is varied both as
amount of information presented, and number of decision opportunities per unit
time.

All of these operations are conducted simultaneously within the simulation.
Each subject experiences randomly programmed changes in information presentation
rate during the scenario. The microcomputer-based scenario also provides for
embedded assessment both of complexity and of behavioral reliability.

Through this approach we hope to establish a conceptual link between the
inherent cognitive style an individual uses to input, organize, and act on
information and his overall behavioral reliability in regard to a specific job.
We also are able to descern the effects of information rate on this relationship.

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HUMAN RELIABILITY AS A FACTOR IN SECURITY

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HUMAN RELIABILITY AS A FACTOR IN SECURITY

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If those of us who deal with human error accidents did not share a fundamental belief that these accidents are caused, then we would not be here discussing them. Like the Bedouins, we would fold up our tents and disappear into the night. That we are here is testimony to our belief not only in the existence of causal factors for human error accidents, but in the eventual discovery of these causes and their elimination.

For purposes of this analysis, it is assumed that human error accidents may be classified into one of the following causal categories:

1. equipment design that interferes with efficient human performance or encourages inappropriate human behavior;

2. personnel selection procedures which place humans in jobs that exceed their capability (regardless of equipment design or training);

3. training of personnel that is inadequate, inappropriate, insufficient, not sufficiently recent, or just wrong.

4. intentional human actions, precipitated by perceived wrongs or injustices and carried out as psychotic, immature or neurotic response mechanisms (from some viewpoints, these are not accidents);

5. non-intentional human actions, caused by stresses which exceed individual tolerance levels (fatigue, workload, boredom, and other situational stresses; along with personal stresses such as death of a loved one, financial difficulties, or material problems).

Thus defined, the category of human error accidents tends to disappear. Each of these five sub-categories has an objective cause which can (theoretically) be discovered and corrected. This paper presents the results of an analysis of the work done by operations technicians at independent spent nuclear fuel storage installations. It reports on actions taken to preclude accidents in three of the five causal categories, and presents an approach to preventing accidents caused by the remaining factors.

Earlier this year, under contract to Sandia National Laboratories, the authors conducted a task analysis of the work of operations technicians, the primary workers at independent spent fuel storage installations (ISFSIs). The Morris, Illinois ISFSI was selected for detailed analysis (Hottman, Bateman, and Biers, 1982). The study was initiated to answer the following questions:

1. What skills are necessary to be an effective ISFSI operations technician?

2. What areas and levels of technical knowledge are necessary for the operations technicians to operate the facility safely?

3. What type of examination/certification procedure would best verify the presence or absence of the skills and knowledge necessary to operate an ISFSI safely?

The purpose of the study was to provide a technical basis for initial and continuation training for operations technicians. The task analysis provided data on task difficulty, frequency, hazard level, likelihood of error, and time spent on the tasks. The same data that identified the more difficult, hazardous and error-likely tasks also pointed to deficiencies in equipment and task design. In the process of interviewing supervisors, data on personnel selection was obtained.

The spent nuclear fuel receipt/storage cycle is as follows: (1) casks containing spent fuel are off-loaded from the transport vehicle; (2) each cask is placed by crane in the unloading pit: (3) fuel is removed from the cask under water and transferred to a storage basket; (4) storage basket is placed in one of the storage basins; (5) cask is removed from the unloading pit; (6) cask is decontaminated and surveyed; (7) cask is loaded onto transport vehicle and shipped off-site. The time required for this entire procedure depends upon several variables including the type of cask, weather, time of day, shift size, and backlog. Because a majority of the fuel receipt/storage work occurs under water (for radiation protection purposes), the operations technicians may employ various devices to enhance their fuel basket tool manipulation coordination. These devices include underwater TV camera, underwater periscope, and/or binoculars.

Following receipt, unloading, and storage of the spent fuel, operations at an ISFSI focus on maintaining the fuel bundles in a safe and secure environment. The basin (or pool) in which the fuel is stored to prevent contamination of the environment must be cooled and the water filtered to remove impurities which may transport radioactive sources. Filter material and other substances that have been exposed to contamination must receive special handling and be stored in a Low Activity Waste (LAW) vault. Installation systems must be checked for proper operation to prevent leaks of contaminated air or water. Fuel accountability checks must be made and radioactivity must be monitored to ensure that the entire system is under control. Once the fuel has been stored, the ISFSI operation becomes more of a process monitoring than a materials handling situation.

Because the receipt of fuel was not accomplished during this study, actual observation of work activities was not possible. Data was gathered on 16 activities (217 tasks) which were judged to be typical of routine operations. From the results of the Task Inventory, there emerged a list of 63 tasks, approximately 30% of the tasks selected for analysis, which merited additional attention. For a task to be included on this list, it had to meet the criterion of being rated above average in at least one of the following categories: difficulty, hazard, or error-likely. Twenty-five of the tasks were judged to be both difficult and hazardous; one was judged to be both difficult and error-likely; ten

tasks were rated difficult; seven were rated hazardous; and twenty were identified as error-likely.

This information, along with data on frequency and time spent, was analyzed in order to make recommendations on training and certification procedures. The existing training program at the Morris ISFSI was analyzed in detail to obtain baseline data on the training of operations technicians. Training documents were studied, actual training materials were reviewed, and training and testing records were examined to determine what was being done. For comparison, material from the training program at the Barnwell Nuclear Fuel Plant was reviewed.

Supervisors at Morris were interviewed and a preliminary job analysis was used to determine required operator skills. Training, safety, and operating documents and checklists were reviewed and task inventory forms were developed with the help of ISFSI supervisors. Operations technicians were then interviewed and the task inventory forms filled out with information on task frequency, difficulty, hazard, time to complete, and error potential.

The operations technicians play a vital role in the operation of the ISFSI. This is apparent from the analyses of the tasks and activities performed by the operations technicians. They constantly monitor crucial systems, work closely with hazardous substances, and respond quickly and appropriate to abnormal and emergency conditions. The performance of operations technicians directly affects the safe operation of the ISFSI and the safety of plant personnel.

More importantly, the public perception of the reliability of the personnel directly influences attitudes towards the ISFSI. The entire operation must not only be safe, it must appear to be safe. The loss of public confidence in the safety of any nuclear facility, or in the competence of the personnel working there, can adversely affect the entire industry.

Given the importance of the job, it follows that individuals assigned to this job must demonstrate that they possess the knowledge, skills, and abilities necessary to perform as operations technicians. This is accomplished through a certification program which is designed to ensure that individuals meet the minimum qualifications for job performance.

It must be emphasized that certification is not simply demonstrating qualifications on a single certification test. The certification test should be a major milestone in a larger program starting with personnel selection and including initial training and practice prior to certification. It would also include proficiency training to assure compliance with performance standards and to update technicians on new procedures and techniques.

The following recommendations are based on the results of the task and activities analyses, the analyses of supervisor's surveys and the review of the training and certification program in effect at the Morris ISFSI. Recommendations are grouped according to the concept of a comprehensive certification program which includes personnel selection, training, practice, testing, certification, and recertification.

The selection of personnel for the job of operations technicians is the starting point of the certification process. Personnel selection involves considerable expense and always involves risk. There is no technique to guarantee that the applicant will successfully complete training or perform satisfactorily on the job. A thorough understanding of the job tasks, skills and knowledge required by operation technicians enables a manager to make better selection decisions. Applicants possessing more of the skills and knowledge required to do a job should perform better in that job.

The task analyses and interview data from supervisors and operations technicians provide the kind of job task information which can be used to improve the probability of making sound personnel selection decisions.

Based on interview data and the task analysis data, it is possible to recommend minimum levels of education and experience for applicants for the job of operations technician. A high school education or GED certification is recommended. The job does not require an education level beyond high school. Applicants with higher education credentials may not be sufficiently challenged by the tasks and may experience boredom or overconfidence. Recommended high school courses include mathematics up to and including algebra and basic science. Courses in chemistry and physics would be desirable.

Based on the survey data, we found that supervisors felt that previous job experience was not critical. The general consensus was that no nuclear-related experience was required and that this could possibly be a first job.

These objective conclusions do not include the subjective opinions volunteered by supervisory personnel. It was felt that reliability and dependability of prospective employees was far more important than skill level and experience. For this reason, managers looked at such factors as maturity, continuity of employment records, and history of absenteeism when such data was available. Deliberate, methodical performance of assigned tasks was judged more important than creativeness and innovative ability. It should be noted that decisions in hiring have been based upon subjective judgment rather than any objective measurements.

The use of personality tests, such as the MMPI, Cattell 16 PF (Personali*y Factor), Rorschach, and Thematic Apperception Tests for critical positions such as airline pilots has been well documented in this country (Mayer and Treat, 1977) and abroad (Okaue, Nakamura, and Niwa, 1977; Kirsch, 1976; Kaspras, 1979; Pokrovskii, 1975; Kumar, 1979; and Nagay, 1965). The use of such tests for nuclear facility personnel has been described in NUREG/CR 2075 (Frank, Lindley, and Cohen, 1981). Psychological characteristics of nuclear workers have been documented (Constant, Grimm, Golden, and Murcko, 1976). Use of these personality tests provide an initial screening of potential employees and should minimize the risk of human error accidents caused by intentional, irrational human actions.

Once employees have been screened and selected, they must be trained. In July 1981, the results of a safety evaluation of the ISFSI at Morris, Illinois were reported (NUREG 0709). In concluding that the operator training and

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certification plan met the requirements of 10 CFR 72.92, the report did little more than acknowledge that there was an established training program which included some proficiency testing and that there was an established certification procedure. In a rather brief description of the comprehensive training program, it is noted that the certification program is inspected by the NRC Office of Inspection and Enforcement as to the quality of the examination and the reasonableness of the grades required for passing.

During SRL's study of the Morris facility, the training program for operations technicians was reviewed in detail. Slides and videotapes were reviewed, lesson plans were read, and the overall training plan was studied. In discussions with Morris personnel, the method of developing training materials was reviewed. Members of the research team who visited the facility actually received the indoctrination training for safety and security. It was our conclusion that the academic training program now in existence was well conceived and accomplished. The two-year cycles appear to be adequate as long as special training is conducted on changes in systems or regulations as they occur. Furthermore, it was our recommendation that companies that operate ISFSIs continue to design and conduct their own training programs. The approaches, time spent, and media used can be expected to vary according to operator preferences and the skills available among employees.

By monitoring training programs, the responsibile agency can assure itself that there will be a minimum number of human error accidents caused by workers who were not properly trained.

In evaluating the tasks performed by operations technicians and the equipment available for use in task performance, we found some discrepancies and areas for improvement. Such deficiencies will continue to exist until government and industry insist upon competent and comprehensive safety and human factors engineering as requirements for system design. Stated positively, the insistence of proper human factors engineering during the initial specification and design of equipment will help to minimize human error accidents caused by faulty equipment.

If we are to improve on human reliability as a factor in nuclear security and safety, it is imperative that we use the current technology to improve on personnel selection, job design, equipment design and training. Unfortunately, the state of the art in preventing accidents caused by non-intentional actions of trained and competent personnel using well designed equipment is not fully developed. There has been some research on accident proneness and the use of data on "life changes" to identify personnel who are likely to be involved in an accident (Alkov and Borowsky, 1979; Rahe, 1978; Levine, McHugh, Lee, and Rahe, 1977; Selzer and Vinokur, 1974; Tillman and Hobbs, 1949; Conger, 1977; Reinhardt, 1966; Sanders and Hoffman, 1975; Alkov,1981; Fine and Hartman, 1968; Alkov, Borowsky and Gaynor, 1982).

All of the research performed to date is based upon the thesis that life changes create internal stress which demands coping strategies and behaviors (Alkov and Borowsky, 1979). When this internal psychological stress is added to the mental and physiological stresses inherent in task performance, efforts at

adaptation may cause fatigue and failures of the coping mechanisms. The breakdown of the coping mechanism may produce illness or accidents.

In studies to date, researchers have evaluated correlations between life changes and accidents. In groups of naval personnel, the correlations between some life change events and accidents, while small, have been highly significant (Alkov, 1981; Alkov and Borowksy, 1979). Life change events which precipitate accidents seem to vary with the age of the subject for traffic accidents (Selzer and Vinokur, 1974) and for job related accidents (Levine, McHugh, Lee, and Rahe, 1977). A major problem has been the large number of personnel who do have a significant number of life changes yet have not had an accident.

An analysis of this problem reveals that life changes themselves are not responsible for the accidents. It is the existence of more changes than a person can cope with that elevates stress, produces fatigue, and causes lapses in attention that lead to human error-caused accidents. In order to make life change data useful in accident prevention, it is necessary to evaluate the stress levels as they relate to an individual's capacity or tolerance for stress. While it may be that self-report personality inventories can provide data on stress tolerance levels as well as the current level of stress, definitive research to verify this has not been done. If a level of stress tolerance could be established, then life change events could be evaluated in terms of individual capacities.

In his book Adaptation to Life, George E. Vaillant (1977) describes eighteen mechanisms which are used to cope with stress. These mechanisms may be grouped into four categories. These categories may be ranked according to their goodness, or success in dealing with stress. First, mature mechanisms, the most successful of the four, include sublimation, anticipation, suppression, humor, and altruism. Second, neurotic defenses are less successful. They include dissociation, reaction formation, displacement, repression, and intellectualization. The third category, immature mechanisms, includes acting out, passive-aggressive behavior, hypochondriasis, schizoid fantasy, and projection. Alkov (1981) points out that extroverts tend to use acting out and aggressive behavior to deal with stress, while introverts tend to become hypochondriacal. These inadequate mechanisms have been observed in individuals involved in human error-caused accidents. The fourth, and least effective group of mechanisms, is called psychotic. It includes distortion, denial, and delusional projection. Individuals in this group are likely to be so far removed from reality that they are unable to deal with on-the-job events.

By identifying the coping mechanisms that are used by an individual, it should be possible to get at least a rough estimate of his capacity to deal with stress. When Life Change Units (LCUs) or the weighted Subjective Life Change Units (SLCUs) are used to evaluate the current stress level (Rake, 1978), the existing level may be interpreted as a fraction of capacity.

Intriguing as the theory may sound, it is still a long way from practical use. There is a need to establish norms for the populations of interest (security guards, weapons handlers, and others who deal with nuclear material). Differences due to age, already identified, need to be quantified. Actual correlations

occurring in the specific population of interest, along with their significance level need to be determined. Finally, management decisions on maximum stress levels need to be made.

In dealing with human reliabilty, we have the tools to reduce human error accidents caused by equipment, selection, training, and intentional irrational behavior. The theory needed to prevent non-intentional human errors caused by stress is in a development stage. To move from construct to established theory and on to definition of a usable tool for providing better security for nuclear systems, a dedicated research program is required. With sponsorship of goal oriented research programs, the nuclear community can achieve the reality of prevention of nuclear accidents.

SIGNIFICANT LIFE CHANGE FACTORS

MARITAL PROBLEMS	0.0202
IMMATURE/UNSTABLE	0.0324
RECENTLY ENGAGED	0.0411
CAREER DECISION	0.00:7
RELATIONSHIPS (PERSONAL)	0.0047
RELATIONSHIPS (SUPERIORS)	0.0029
SLOW TO ASSESS	0.0047
TROUBLE WITH PEERS	0.0279

- Alkov, Borowsky, Gaynor (1982)

RATIOS BETWEEN AT FAULT AND NOT AT FAULT

AT FAULT	NOT AT FAULT	RATIO
.08	.03	2.7
.05	.02	2.5
.04	.01	4.0
.22	.12	1.8
.08	.02	4.0
.08	.02	4.0
.08	.02	4.0
.06	.02	3.0

- Alkov, Borowsky, Gaynor (1982)

SIGNIFICANT LIFE CHANGE FACTORS AND CORRELATIONS

	r	p
ATTEND CHURCH MORE	0.22	0.01
.....		
JAIL	0.09	0.05
UNWANTED PREGNANCY	0.10	0.05
PARENT REMARRIED	0.10	0.05
PHYSICAL FIGHT	0.11	0.05
AUTO ACCIDENT	0.11	0.05
DIVORCED	0.11	0.05
CHILD DEATH	0.11	0.01

- Levine, McHugh, Lee, Rahe (1977)

MECHANISMS FOR COPING WITH STRESS

MATURE
SUBLIMATION
ANTICIPATION
SUPPRESSION
HUMOR
ALTRUISM

IMMATURE
ACTING OUT
PASSIVE-AGGRESSIVE
HYPOCHONDRIASIS
SCHIZOID FANTASY
PROJECTION

NEUROTIC
DISSOCIATION
REACTION FORMATION
DISPLACEMENT
REPRESSION
INTELLECTUALIZATION

PSYCHOTIC
DISTORTION
DENIAL
DELUSIONAL PROJECTION

- Vaillant (1977)

CAUSES OF HUMAN ERROR ACCIDENTS

- EQUIPMENT DESIGN
- INDIVIDUAL ABILITY
- TRAINING
- IRRATIONAL ACTS
- STRESS/FATIGUE

FINDINGS AND RECOMMENDATIONS

- EQUIPMENT DESIGN
- INDIVIDUAL ABILITY
- TRAINING

TASK ANALYSIS OF OPERATIONS
TECHNICIANS AT A SPENT FUEL INSTALLATION

- DIFFICULTY
- FREQUENCY
- HAZARD LEVEL
- LIKELIHOOD OF ERROR
- DURATION

AREAS NOT SPECIFICALLY ADDRESSED

- IRRATIONAL ACTS
- STRESS/FATIGUE

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NEW APPROACH TO SECURITY ANALYSIS

BY

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Mr. Alberts received his Bachelors Degree in Physics and Mathematics from Queens College in 1949. He joined the U.S. Army Ballistic Research Laboratories at Aberdeen, performing research into shock diffraction and supersonic flow. After receiving a Master of Science Degree in Physics and Mathematics from the University of Delaware, he became Director of Requirements at the U.S. Air Force Cambridge Research Center, Geophysics Division, and developed research programs for that broad technical area. In 1956, Mr. Alberts began an industrial career, joining AVCO Corporation as Assistant to the President and Head of the Operations Analysis Group responsible for all OR activity within the corporation. There followed a period of work in laser and maser communications systems, while serving as Northeast Manager for Cook Electric Company and Assistant Director of Research at National Company.

Mr. Alberts joined Stanford Research Institute in 1962 as Director of Instrumentation for the Research Office at Fort Ord, California. He then served as a technical advisor to the Commanding General, U.S. Seventh Army in Germany, and performed consulting services for European Industry operating from SRI's Stockholm Office.

Returning to the United States in 1968, he served as a consultant to the U.S. Commission on the Causes and Prevention of Violence and to ARPA. Mr. Alberts founded the VERTEX Corporation in 1969. He developed and operated computer accounting, inventory control and forecasting systems for commercial clients such as Dart Drug and Hechingers. He joined General Research Corporation as Director of the Logistics Department in 1975, serving as technical advisor to the Joint Logistics Commander, DoD Material Distribution System Study and conducting research in a number of diverse areas, from economic projections of European industrial activity to Navy Compensation Policies.

Mr. Alberts received Citations from the U.S. Army Combat Development Experimentation Center and from the U.S. Commission on the Causes and Prevention of Violence.

NEW APPROACH TO SECURITY ANALYSIS

I.   INTRODUCTION

When Aristotle introduced his logical reasoning process, "scientific method" was just a step away. The extension of Aristotelian logic to the observation of physical things required, basically, that empirical rather than logical evidence be used to examine and analyze the physical world. Use of this "scientific method" has required that any empirical evidence presented be reproducible. Data reproducibility, reliability, and validity were the test of data truth. Clearly, proof of reproducibility has established a requirement for objective measurements.

For these reasons scientific methodology was first applied to physical things. It was easy to measure something and to verify that measurement by independent observers. The thing being measured had no opportunity of choice - inanimate things cannot make decisions about their length, width, or breadth. Once constraints have been established, the behavior of objects within the natural world is not often subject to debate. Bodies falling within the earth's gravitational field tend to do so with a predictable trajectory.

Even when there has been uncertainty about the behavior of things in the physical world, as, for example, in predicting decay of individual unstable particles, that uncertainty may be attributed to incomplete information about constraining conditions rather than by an inability to understand why decay occurs.

In most real world situations many factors are at play. Acquisition of the full range of detailed information necessary to predict the occurrence of an event or its outcome is extremely difficult. Thus, the concept of probability is usually applied. Probability was first applied to games; it is applied routinely now to the world of micro-matter. Today, increasingly, probabilistic concepts are used (sometimes inappropriately) for almost every aspect of real world measurement.

Because a completely detailed set of conditions which affect behavior are often not specified (or even known), many programs which produce behavorial measurements provide results which turn out not to be reproducible. Or, if reproducible, they seem difficult to integrate with other results obtained in like kinds of measurement programs.

The concept of sampling, and indeed sampling theory itself, was developed to overcome difficulties associated with population heterogeneity. Devising a good sample structure based on measurable population characteristics has provided better measurement-result reproducibility.

However, simple statistical sampling concepts may in themselves be insufficient to provide for good result reproducibility. There are perception differences about their world and about the relative importance of things in it, even among individuals with similar stratum characteristics. When individuals face situations where a choice is required among a myriad of real world alternatives, those perception differences often generate wide divergence in the kinds of decisions people take.

The inanimate object has no choice but to follow a minimum energy tra-
jectory when in motion between two points. Human beings, however, can go from New
York to Chicago by way of Atlanta if they choose to do so. Therefore, it seems to
us that dealing with the real world, where people and things interact, requires a
more inclusive mathematical basis than is provided by probability theory alone.

Perhaps the earliest comprehensive methodological statement useful to
examine human choice alternatives was developed by Von Neumann and Morganstern in
their original treatise /1/ on game theory. Their contribution was manifold - the
concept of alternative action strings was stated, the zero-sum concept was developed
and put to use, a practical basis for the use of Markov Chains was stipulated. In
fact, most network analysis techniques, from the original work of Ford and Fulkenson
through "pert" and modern fault tree analyses, are based on the concept of chains of
events as developed by Von Neumann and Morganstern.

The original game theory makes only gross distinction between levels of
difficulty in accomplishing a chain of events. Its original scope of application
made such considerations unnecessary. Yet, when event chains become formalized
(as in network theory), we need some way to differentiate practical from impractical
branches. We want to know whether a branch, if chosen, can be traversed. If we
want to determine critical branches in complex processes (critical path analysis),
we need to define some measure of the "ease" with which a network branch can be
traversed.

Determining how easy something is to accomplish is, in the end, a matter
of opinion. One may have evidence to support an opinion (and ideally there should
be some), but there is no independently determinable, single value for the quality
of "ease"; there are only perceptions of difficulty. Nor is it usual to find total
agreement on the particular factors that influence task accomplishment or their
relative importance with respect to each other or to the task.

In fact, except in those limited cases where only two possibilities can
occur, all other real life situations involve many alternatives, each of which may
be perceived to have some range of relative importance and some range of probabi-
lity of occurrence. To us, dealing with these kinds of real life situations seems
to call for integration of a number of mathematical techniques.

Unfortunately, there is usually little chance to measure quantitative
data directly in these kinds of situations. Quantitative data regarding the rela-
tive importances of groups of things with respect to each other, with respect to
any decision taken, and with respect to the outcome of that decision needs to be
developed from qualitative information.

There is yet another requirement generated by the kinds of real world
problems that we want to consider. The results of decisions taken in the past act
to limit decisions which can be taken in the future.

All of these aspects of real world analysis generate a need to develop a
time iterated, dynamic set of data and to form it into a data continuum.

If, to this point, the statements made about the mathematical difficulties of dealing with our real and complex world fairly represent the case, then this slide (slide 1) presents a summary of currently available mathematical techniques useful in dealing with those kinds of problems.

II.   PRIOR HISTORY OF TECHNIQUE DEVELOPMENT

Even with such a wide array of mathematics available, forming a data continuum is a challenging task unless we can devise some kind of overall framework to guide us. We believe that such a framework can be built using process control and feedback concepts. If problems are formulated in terms of those kinds of networks, and if the networks are interconnected by feedback loops where the processes they describe are defined to be interactive, then we can not only form a closed mathematical structure but also exercise it practically.

A first attempt to apply these concepts to a real life situation was made during the course of the work of the United States Commission on the Causes and Prevention of Violence (The Eisenhower Commission). In 1968-1969 a model of the crime of assassination was developed. The model was constructed in the form of sets of networks representing the physical aspects involved in assassinating a public figure. The model was programmed and exercised on an IBM 360-65 computer at the Stanford Research Institute. The networks describing the physical possibilities of successful assassination were used to develop quantitative measures of the "assassination potential," the ease with which a target could be eliminated, as hypothetical public figures went about their daily business. To "test" the model, detailed schedules were produced for movements of Abraham Lincoln and William McKinley. Their daily movements were formed as a set of process flow networks. The physical conditions under which their daily scheduled movements occurred were entered into the computer as sets of inputs to those networks. At each point in time, assassination potentials were computed and isobars of constant threat were developed.

Clearly, there could be no real test of model validity. However, in the course of model exercises, considerable information emerged concerning the ways in which various kinds of protective measures could affect assassination potentials. Sufficient detailed information was developed to cast doubt on the wisdom of publishing an open report. Some measure of the worth of the approach can be inferred from the fact that the U.S. Secret Service, Bureau of Protective Intelligence, classified the report as "non-releasable," collected a list of everyone who was privy to its content, and recommended that the Commission issue a citation to the authors.

The second time, this approach was used to create a framework or structure useful to study the crimes of burglary and robbery. Again, the real world physical limitations were established and process flow networks were generated to represent means which could be used to commit those crimes. Funding problems precluded their full programming and test.

ANALYSIS METHODOLOGIES

METHODS WHICH TRANSFORM SUBJECT INFORMATION INTO QUANTITATIVE TERMS

Analysis Method

Utility

LIKERT SCALES

PROVIDE A SIMPLE UNFORCED, BUT GUIDED BASIS FOR TRANSFORMING QUALITATIVE INFORMATION INTO QUANTITATIVE RELATIONSHIPS.

ALTERNATIVE HIERARCHIES

EXTENDS THE LIKERT CONCEPT TO MULTI-DIMENSIONAL PROBLEM STATEMENTS. CAN BE EITHER UNFORCED OR FORCED (SAATY'S METHOD).

METHODS WHICH CAN INCLUDE QUANTITATIVE INFORMATION DIRECTLY

PROBABILITY ANALYSIS

PROVIDES THE FUNDAMENTAL BASIS TO MAKE QUANTITATIVE STATEMENTS ABOUT NETWORK; GAME, AND DECISION THEORY.

NETWORK THEORY

LAYS OUT POSSIBILITIES IN A LOGICAL MANNER. A STRAIGHTFORWARD METHOD OF ARRIVING AT ALL CONTINGENCIES.

GAME THEORY

INTRODUCES THE IDEA OF DIFFERING VALUE JUDGMENTS AND VIEWPOINTS. TAKES ALTERNATIVES OF NETWORKS AND SEARCHES FOR ADVANTAGES IN CERTAIN OF THEM FROM VARIOUS VIEWPOINTS.

DECISION THEORY

EXPANDS THE CONSEQUENCES OF NETWORKS, TAKEN FROM DIFFERING POINTS OF VIEW. PROVIDES QUANTITATIVE MEASURE OF ADVANTAGE FOR COMPLEX DECISIONS.

FAULT ANALYSIS

APPLIES "NETWORK AND PROBABILITY ANALYSIS TO FAILURE ASSESSMENT. MORE COMPREHENSIVE ANALYSIS THAT "RELIABILITY" ANALYSIS.

III.   METHODOLOGY EXTENSION TO OTHER KINDS OF PROCESSES

Other kinds of security problems may be more tractable than either of the previous applications. When targets are stationary and well defined, one might use a wide variety of modern devices to inhibit assault and to limit the success of any assaults once undertaken. The point is that once we have clearly specified the physical possibilities of attack, the event chains which describe how each assault plan would need to be formulated and pursued could be established with some certainty. Once that kind of information was developed, group-type psychological profiles could be postulated to describe individuals who might undertake those kinds of actions.

The flow of logic indicated in this discussion is shown in this slide (slide 2).

There are some new aspects to this kind of vulnerability analysis technique. Most vulnerability models in the literature appear to be static models; they consider singular events, analyze possible effects if the events occur, and indicate steps necessary to nullify those effects. Few derive chains of sequential effects in the form of if-then events. The methodology we propose to use presents vulnerability analyses in the form of chains of events. In this kind of analysis, each event is treated independently, but the effects the event has, depend upon the situation at the time it occurs. That situation has been created not only by, but in context of all prior events which have occurred. In short, conditions prior to an event are established as cause-effect results of all previous events. Situations where, for a given cause, the effect depends upon the sequence of events which preceded it are the opposite of Markov Processes. In a Markov Chain, event choices and the effects of events which occur depend only on conditions at the time of occurrence, not on the precedent events sequence; events are excluded independently of prior events and conditions.

Here events are generated within the context of process flow networks. An event is defined as something happening which has an effect, either positive or negative, on the process flow output. Events can generate feedback effects on the network.

The cumulative effect of taking this kind of overview of the world is to add a dynamic response dimension to the problems of maintaining optimum flow processes under conditions of attack.

The following discussion uses various kinds of systems to illustrate the analysis process. Energy resource systems serve as one example of methodology application. Non-energy resource systems provide other examples. All of the systems we will discuss provide for the flow of generic entities, i.e., non-fuel minerals or other kinds of goods such as information, water, and food. Threats to such systems aim at degrading system output (in terms of either volume or quality).

The basic components of a dynamic system mode are:

LOGIC OF THIS METHODOLOGY

I. DETERMINE

- HOW operational utility can be reduced or eliminated.

- WHAT actions are needed to do it.

- WHERE those actions must be taken.

- WHEN is the best time to take them.

II. EXAMINE the how, what, where, when, of potential action patterns to determine psychological characteristics of individuals who might undertake them.

III. USE generalized categories of individual characteristics as an input to develop security countermeasures.

1. A process flow network which fairly represents the process (PFNM).
2. One or more multi-loop interconnected feedback network models (MIFNM).

A process flow network is composed of entities called process elements. Each element is part of the generic flow process. This slide (slide 3) presents generic energy flow processes.

The series of actions taken to perform resource extraction is called the "extraction process element." This element operates on the resource in its base form (for example, coal directly from a mine, gas as it comes from the well, shale which contains oil) to produce a refined solid, liquid or gaseous form of that resource.

The process element performs its function where the resource is found (in-situ), for instance a mine. It operates to collect, harvest, or, in the case of more sophisticated processes, breed the raw material and transform it into a more refined bulk form.

The bulk conversion process element uses the refined resource provided by the extraction process element. This process element produces an end product in some solid, liquid or gaseous form. An example might be a natural gas liquification process which converts bulk gas from the well into liquid which can be more easily transported.

The distribution process element and the storage process element are closely interrelated. Of course the consumption process may occur directly after distribution rather than after a period of storage.
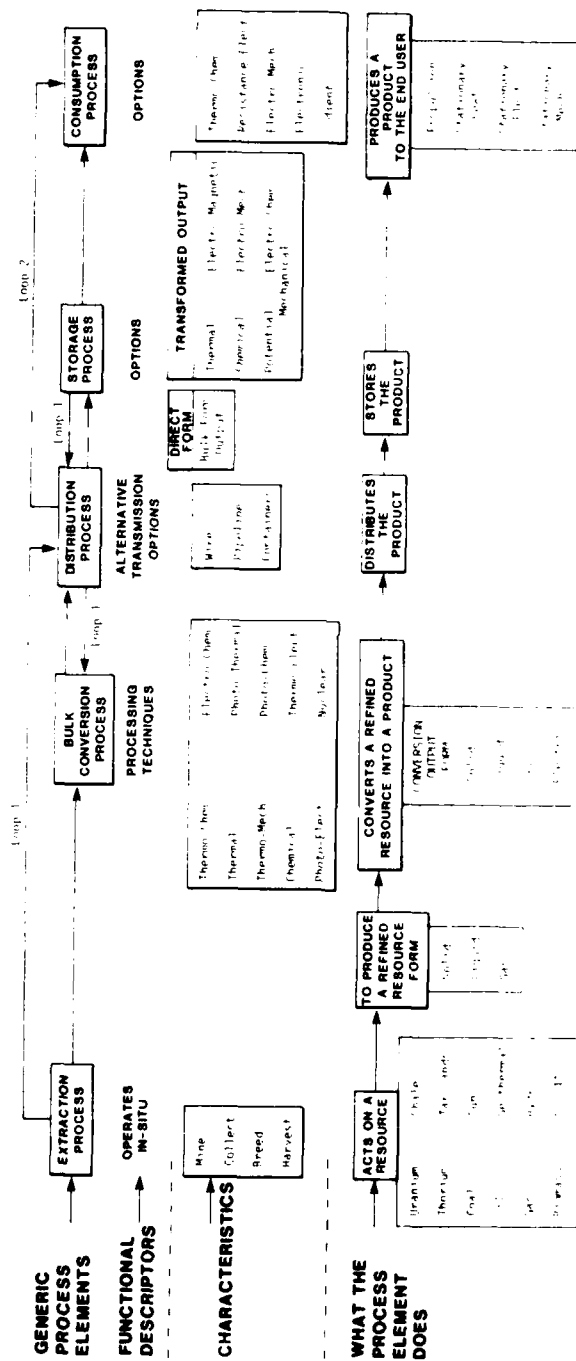
This overlay indicates what each process element does in the flow of material from its extraction to its ultimate use.

This overlay describes some loops between process elements. Loop 1 indicates the possiblity to distribute raw material before converting it. It also shows that there can be two instances of storage, one for the bulk product and another after the product has been refined. Loop 2 indicates that there need not be storage prior to use.

This slide (slide 4) shows a generic flow process for non-fuel mineral systems. There is considerable similarity between the energy system and non-fuel system flow processes. The overlay indicates the generic types of processes that can be used to perform the functions described by the process elements. This overlay shows that there can be a number of loops among the elements, four are indicated in addition to the straightforward one which follows the flow sequence of the process elements as shown (Loop 1). Loop 2 describes a flow sequence of "extraction-distribution-bulk-conversion-distribution-etc." Loop 3 describes a process with the sequence "extraction-storage-bulk-conversion-distribution-etc." Loop 4 indicates that things fabricated for use can then be stored again, and Loop 5 indicates that recycling can be simply another kind of bulk conversion.
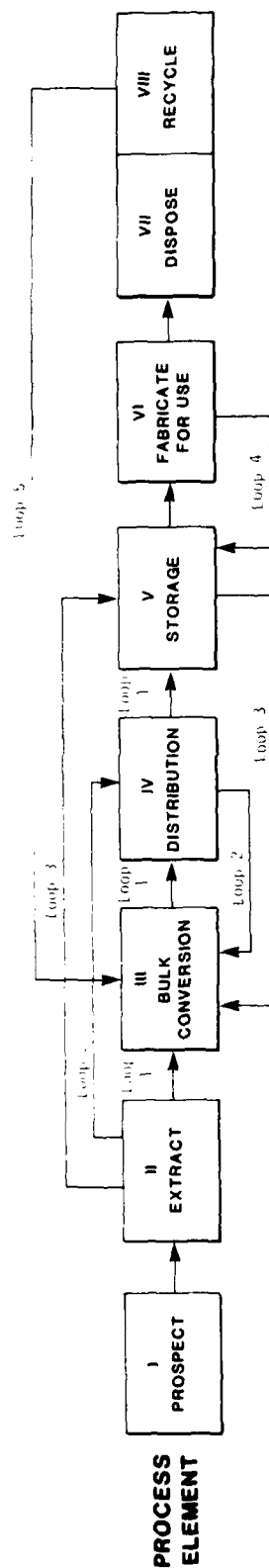
SLIDE 3

GENERIC FLOW PROCESSES FOR ENERGY SYSTEMS

GENERIC PROCESS ELEMENTS

FUNCTIONAL DESCRIPTORS

CHARACTERISTICS

WHAT THE PROCESS ELEMENT DOES

EXTRACTION PROCESS — OPERATES IN-SITU
- Mine
- Collect
- Breed
- Harvest

ACTS ON A RESOURCE
- Uranium
- Thorium
- Coal
- ...
- ...

TO PRODUCE A REFINED RESOURCE FORM

CONVERTS A REFINED RESOURCE INTO A PRODUCT

BULK CONVERSION PROCESS — PROCESSING TECHNIQUES
- Thermo-Chem
- Thermal
- Thermo-Mech
- Chemical
- Photo-Elect
- ...

DISTRIBUTION PROCESS — ALTERNATIVE TRANSMISSION OPTIONS
- Wire
- Pipeline
- Container

DIRECT FORM — Bulk form output

STORAGE PROCESS — OPTIONS
TRANSFORMED OUTPUT
Thermal	Electro-Magnetic	Thermo-Chem
Chemical	Electro-Mech	Electro-Elect
Potential	Electro-Chem	Electro-Mech
	Mechanical	

DISTRIBUTES THE PRODUCT

STORES THE PRODUCT

CONSUMPTION PROCESS — OPTIONS

PRODUCES A PRODUCT TO THE END USER

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SLIDE 4

GENERIC FLOW PROCESSES
FOR NONFUEL MINERALS SYSTEM

As long as the process elements are defined to approximately the same level of detail that is shown in these two slides, the same kinds of flow networking process can be used for telecommunications systems, financial systems, water systems, and physical security systems for important single-target installations. In fact, when individual systems are configured as process flows, they tend to reveal many common features of linear flow. Preliminary analyses indicate that many cross consolidations of disparate process flow networks are possible, thus, simplifying the problem of constructing and modeling a representation of the real world environment.

The process elements of system PFNM's do not simply appear; they require use of resources which create the capability they represent. In this slide (slide 5) the kinds of things involved in creating and using a process element in a command, control, and communications ("C Cubed") process are shown as materials and resources, people, and energy. Dollars available have an effect on all of them. These particular resources, however, are directed toward construction maintenance or repair, operations, and dismantlement of the process element. They are descriptive words for a process element life cycle. The slide also indicates that when events occur which disrupt the normal process elements' operations, taking decisions about output distribution or rerouting may be done by people or by some automated mechanism. The "ingredients" involved in creating and utilizing a process element are derived using a form of analysis called "hierarchical analysis." This methodology usually permits development of quantitative measures of the relative importance of all system ingredients to system status. The slide shows the existence of parallel elements and provision for cross-connecting output to any number of processes or elements which follow. This capability adds considerable utility when damage to an element creates the requirement to establish a set of distribution priorities for the remaining system output. Damage to a main railroad trunk line which impedes troop flow between two points is an example. In that case, maintaining a desired troop flow level might require different allocations of remaining capacity than were provided in the original flow of structure.
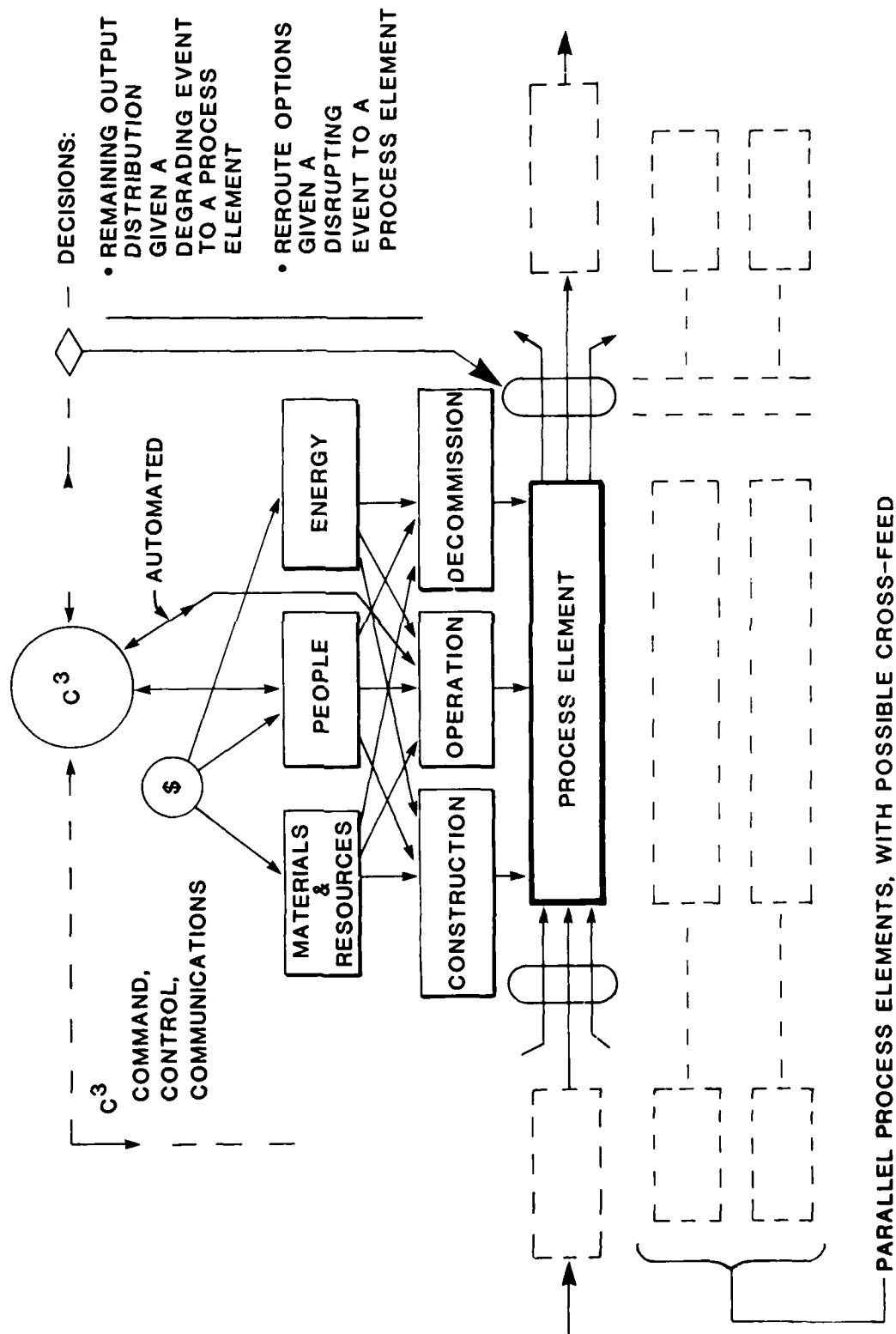
This slide (slide 6) shows some feedback examples. At the left side of the slide, feedback is shown between the mining process and the use of iron ore, and the demand for products made in the production facility.

This overlay adds a more complex dimension. Some of the products of the steel mill are used in another production flow process - refining oil. Here effects of product use on the refining process also have an effect on requirements for steel mill output. The two systems are feedback interconnected. When this kind of situation exists, the process flow network models and the multiple interactive feedback network models are examined together with their interactions; that is, the output from the PFNM's is used as input for the MIFNM's. As changes are made to the individual PFNM's, the synergistic effects of the feedback mechanisms emerge.

When models are constructed and hierarchies developed, the model dynamics can be evaluated. The top of this slide (slide 7) shows four time periods labeled T-1, T-2, T-3, and T-4. T-1 is the period during which the system operates normally and its flow output is at a "normal" level. A disruptive event occurs, and for the
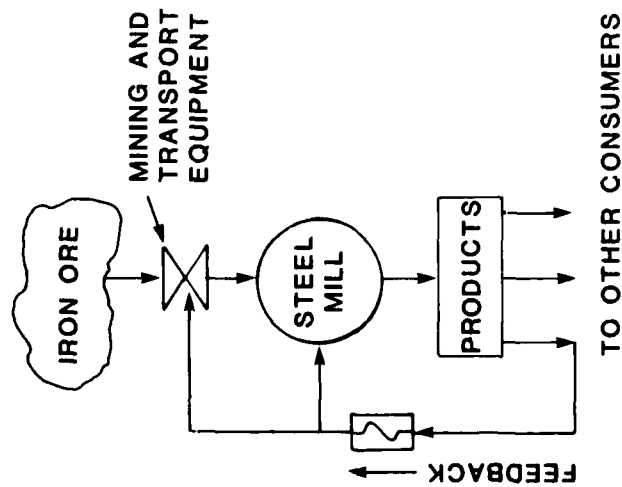
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SLIDE 5
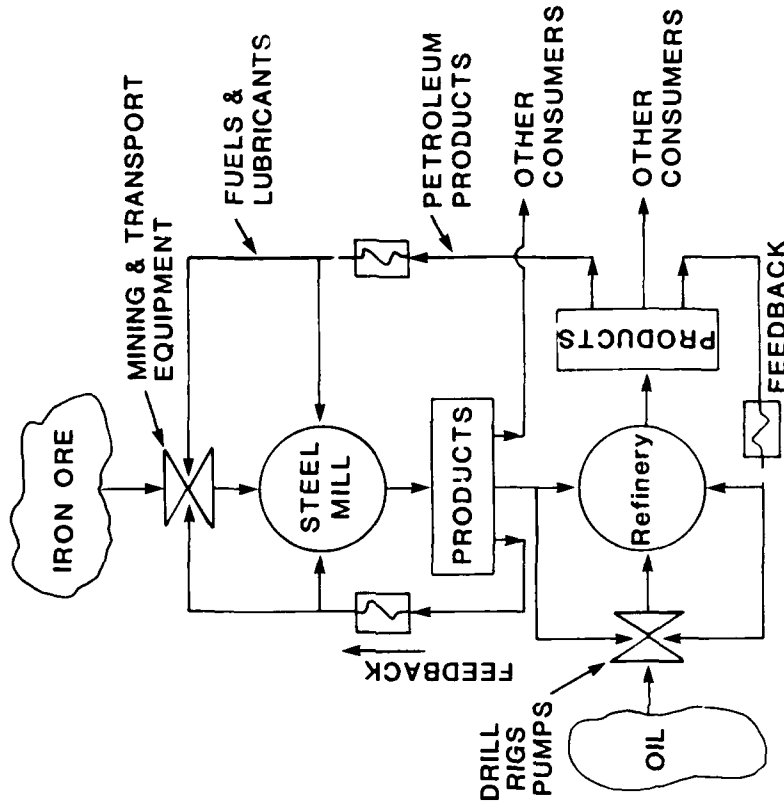
INGREDIENTS FOR A PROCESS ELEMENT

PARALLEL PROCESS ELEMENTS, WITH POSSIBLE CROSS-FEED

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SLIDE 6

FEEDBACK LOOP SYSTEMS

TWO INTERCONNECTED FEEDBACK SYSTEMS

IRON ORE

MINING & TRANSPORT EQUIPMENT

FUELS & LUBRICANTS

STEEL MILL

PRODUCTS

PETROLEUM PRODUCTS

OTHER CONSUMERS

Refinery

PRODUCTS

OTHER CONSUMERS

FEEDBACK

FEEDBACK

DRILL RIGS & PUMPS

OIL

E.G., diesel fuel for drill rigs.

SINGLE FEEDBACK SYSTEM

IRON ORE

MINING AND TRANSPORT EQUIPMENT

STEEL MILL

PRODUCTS

TO OTHER CONSUMERS

FEEDBACK

E.G., steel to make mining equipment, trucks & iron ore barges, steel mill construction & repairs.
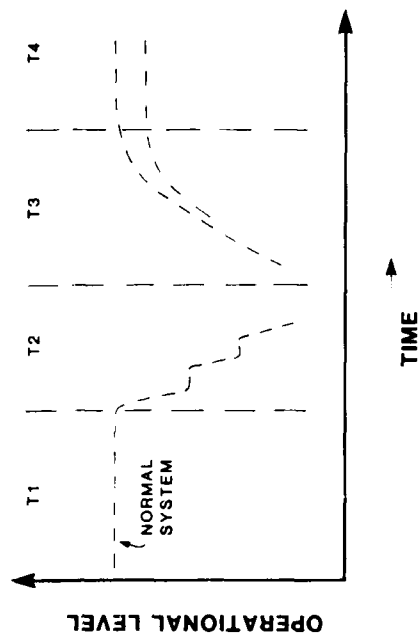
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SLIDE 7

A.

FOUR TIME-PHASES OF A SINGLE EVENT
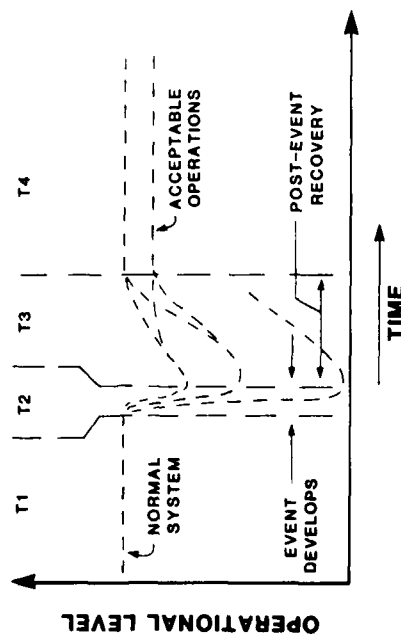
B.

SEQUENTIAL EVENTS
(SAME SYSTEM, OR SYNERGISTIC EFFECTS)

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period indicated as T-2, the event develops and output is degraded. At some point, recovery from the event is undertaken. The period during which that recovery proceeds is labeled T-3. Finally, after recovery is over and output reaches a stable level, the process operates in some acceptable (although perhaps substantially reduced output) manner. Several levels of impeded output are shown to correspond with single events each having its own particular effects on the process flow.

This overlay shows that if the three events (which occur singly in the top of the slide) were to occur in sequence during the time period T-2, there would be synergistic effects between them. In fact, if sequential events occurred, it might serve to reduce the final output level in the T-4 time period below any level caused by the occurrence of any single one of the events.

In addition to any final output reduction caused by sequential events, there may be different effects on the same system or other systems during the same or different event periods when event chains rather than singular events are considered.

Threat scenarios can be constructed using this modeling process. This slide (slide 8) shows that for each process element, various kinds of threats can be postulated. For each of them, a chain of events (analagous to the fault tree shown on the bottom right of the slide) can be defined. Following that chain leads to a disruptive event which degrades process element performance.

In this slide (slide 9) we show the process which produces fuel for a reactor. The processes are familiar ones: extraction, conversion, enrichment, fabrication, and distribution to a reactor facility.

The overlay indicates a reactor power plant. The fuel consumption process is shown in three parts: the first converts nuclear to thermal energy, the second converts thermal to mechanical energy, and the third converts mechanical to electrical energy. The fourth step in the process is the distribution of electrical power, and at the same time, there is disposal of excess thermal energy. The disposal of spent fuel is also indicated - it either goes to spent-fuel storage or to a reprocessing plant for conversion (as indicated by the reprocessing feedback loop). There is another feedback loop indicated between the electrical energy output of the nuclear plant and the enrichment processing plant - enrichment plants use very large amounts of electrical energy to perform their processing.

Finally, this overlay shows an event tree which illustrates things that must occur if the electrical distribution system is to be disrupted. Other chains of events which target the nuclear to mechanical energy conversion process and the mechanical to electrical conversion process could also be drawn. The ability to draw such event trees and to compute how likely they are to occur with (and/or without) human direction was what the work on assassination demonstrated.

As computers continue to improve in computing power and reduce in size, we may now be able to use small machines to model process flows, their feedback mechanisms, and the events necessary to disrupt that flow.

SLIDE 8

THREATS TO PROCESS ELEMENTS

SLIDE 9
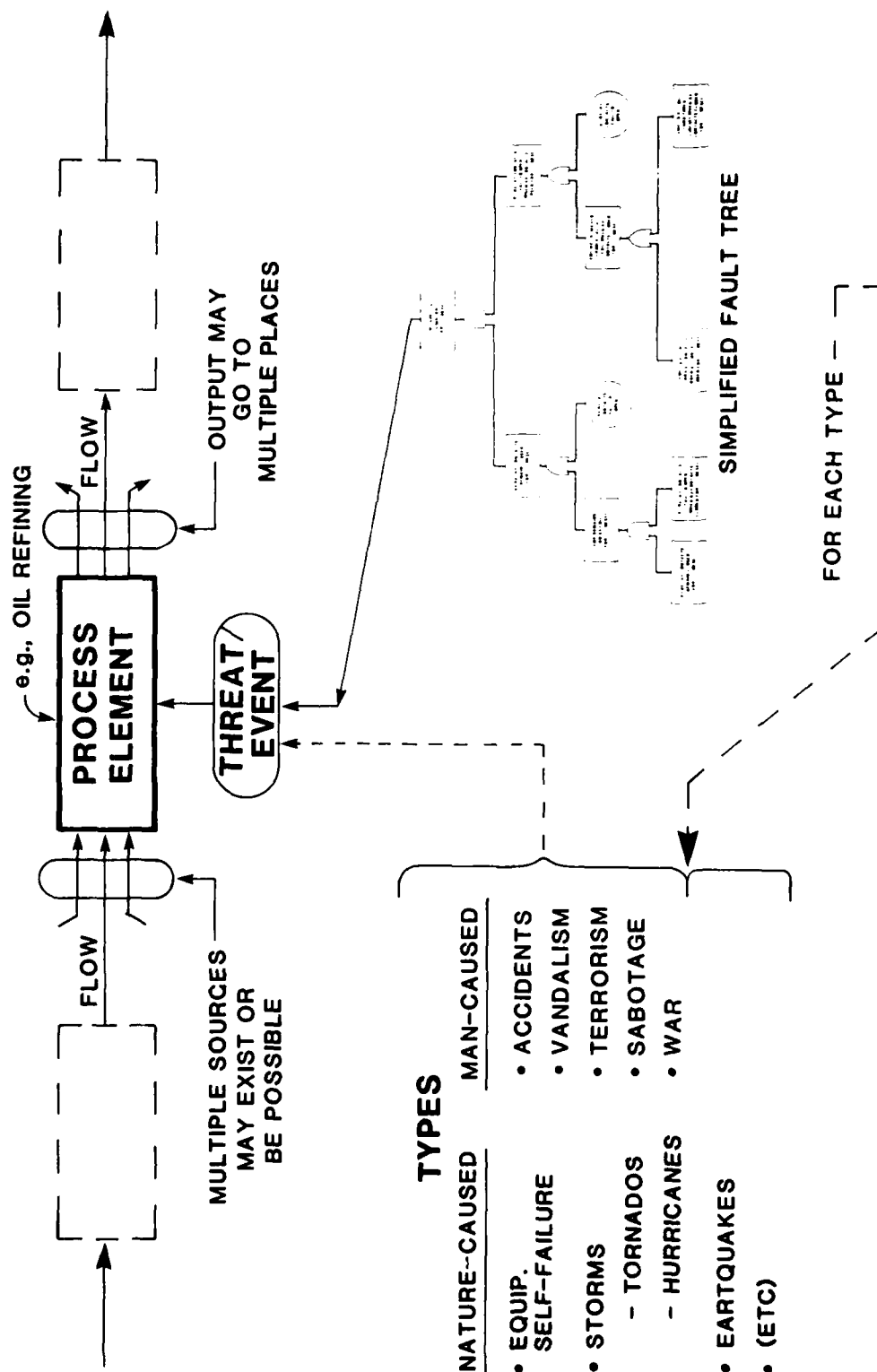
In that way, we believe we could provide quite detailed event trees. We suggest you might use that knowledge together with human behavioral analysis techniques to arrive at a more restricted personality profile of individuals who could be capable of carrying out the chain of physical acts necessary to attack critical facilities.

In fact, an interesting "experiment" would be to:

1. Ask a cross-section of people to draw a process flow sketch and associated fault/event trees for a given system.
2. Obtain such sketches from physical security experts.
3. Obtain such sketches from engineers and system analysts.
4. Compare the results of 1 and 2 against 3, to gain insight as to how non-engineers and non-system analysts understand the process.

Thank you. I'll take any questions you might have now.

AD P 001597

TEAMING HUMAN AND ARTIFICIAL INTELLIGENCE
FOR HIGH-PRODUCTIVITY SECURITY SYSTEMS

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Abstract: Multi-sensor security systems which place primary emphasis on high probability of detection
(PD) of remote equipment only address one third of the overall security problem, which is to
pose a high probability of interdiction. The other two critical steps are communicating
information from the machine to the security console operator (reporting), and dispatch of
personnel (response). Lapses in either of these latter two functions can easily defeat the
goal of near-certain interdiction. For example, a system which depends on a human operator's
sustained attention to a wall of CCTV monitors for eight hours does not adequately address the
reporting problem. Systems where alarms are pouring in too fast to all be responded to are
underplaying the response issue. Throwing more security personnel at the problem does not
appear to be an acceptable solution.

Recent artificial intelligence (AI) progress in computing situation assessments directly from
remote sensor inputs suggests a method for weeding out nuisance-type false alarms in multi-
sensor security systems by building in more discriminability. This approach also fosters
reporting flexibility at the man-machine interface, making it adaptable to event traffic
density. A total systems approach, employing remote sensors, intelligent processing, a well
designed man-machine interface, and trained security personnel offers a well-balanced teaming
of technology and manpower to produce high-deterrence, cost-effective security in coming
years.

I. MOTIVATION

What is security productivity?

The purpose of a security system is to protect the assets and normal operation of an installation
from interference. The "product" of security is ongoing, and consists mostly of deterrence, or
implanting the perception that any attempt to interfere with the installation will result in almost cer-
tain detection, confrontation and punishment. It is interesting to note that the end product of security
is a perception, because this suggests that security creates an essentially cognitive product, as opposed
to a behavioral one. This also explains why it is difficult to quantify security efficacy -- the product
is real, but it is tucked away inaccessibly in the grey matter of many, many human individuals. In this
regard, the subjective impressions of security guards and managers about the vulnerability of their
installation to successful penetration, as reported by Hall in the symposium three years ago [2] , while
they reflect a somewhat biased and possibly over-informed perspective, are getting to the heart of the
matter of what it means to measure how effectively the security function is being performed.

Given that good security consists of posing a credible deterrent against intervention, we can
roughly define security productivity in terms of the quantity of territory or asset-value protected, the
quality level of the deterrent, and the cost of providing security.

$$\frac{\text{security}}{\text{productivity}} \approx \frac{\text{quantity protected} \times \text{deterrent quality}}{\text{cost}}$$

Ideally, the deterrent quality is maintained at a uniformly high level, in which case productivity
increases are mainly to be reaped by expanding the territory protectable per given cost. Where the
perceived deterrent is weaker than near certainty of being caught, tightening of the security net is the
most obvious inroad to increased productivity. Catching an intruder in the act and publicizing his
misfortune raises consciousness about the hazards of interfering with the installation, and causes an
instantaneous "surge" in productivity as we have defined it. Conversely, if news gets out that a
successful penetration has occurred, productivity is instantaneously diminished. This analysis suggests
that security productivity is highly sensitive to the outcome of individual attempts to thwart it, and
underscores the need to maintain an absolutely high probability of interdiction, regardless of how
outsiders may perceive it.

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SPEAKER BIOGRAPHY

MR. PIERRE BIERRE received his M.S. degree in computer science in 1980 from the University of Colorado, where he specialized in database theory, computer graphics, man-machine interface and artificial intelligence (AI). He received his B.S. in physics from the State University of New York at Stony Brook in 1972, where his specialties were psychophysics and perceptual psychology. Since joining GTE Sylvania's Westen Division in 1981, Mr. Bierre has analyzed the future impact of AI technology on multisensor security system information processing and reporting, and has definitized design modifications that will extend the role of remote sensors form detection to automatic alarm assessment. He has also pioneered work in the theory of sensory learning and has articulated several positive ramifications for man-machine interfaces that enhance human productivity. Mr. Bierre has spearheaded the design for several interactive graphic interfaces, and has contributed human factors expertise to the design of numerous equipment projects.

Posing a high probability of interdiction:

The importance of a systems approach

Modern security systems use a combination of humans and equipment to perform the security function. In the Minuteman era, remote sensors tied into a centrally located alarm-reporting display console formed the basis for substantially increasing the territory protected per unit cost, over what was previously possible using guard towers and cyclic patrolling. This paper addresses the topic of how advances in artificial intelligence (AI) will further reshape the nature of the man-machine teaming arrangement in the next generation of security systems, making possible another round of significant productivity gains.

To see how this next major advance will be made possible, we need to take a look at how today's systems operate. Typically, these systems work by having the equipment component draw attention to suspicious phenomena, and by having the human component respond to them. We can generalize two styles of approach -- alarm reporting and continuous assessment. The first approach is indicative of remote sensors, which when appropriately triggered, ring a warning bell, light up a light, or cause an alarm indication to appear on an alphanumeric display terminal. The assessment approach involves the use of remote video cameras and microphones to extend the eyes and ears of the operator on duty. Hybrid schemes, taking advantage of both techniques, use alarm reports to initiate assessment activity, and to steer it to the assessment devices closest to where the alarm was triggered. Regardless of whether the equipment is alarm reporting, assessment, or both, an operator must man the console and dispatch mobile patrol units to investigate irregularities. The entire sequence of combined man-machine activity consists of three equally critical phases: detection, reporting and response.

DETECTION. The remote activity of a threatening nature must be picked up by a remote sensor and passed along to the central security console. In alarm reporting systems, this means that an alarm must be triggered. In assessment systems, it means that the event must be captured in the field of view of the camera or picked up by a microphone.

REPORTING. At the main security operator's console, information about threats must be successfully communicated across the man-machine interface (MMI) to the operator.

RESPONSE. The operator must be able to dispatch a response force to check out and possibly interdict each reported anomaly.

This sequence is depicted graphically in Figure 1.

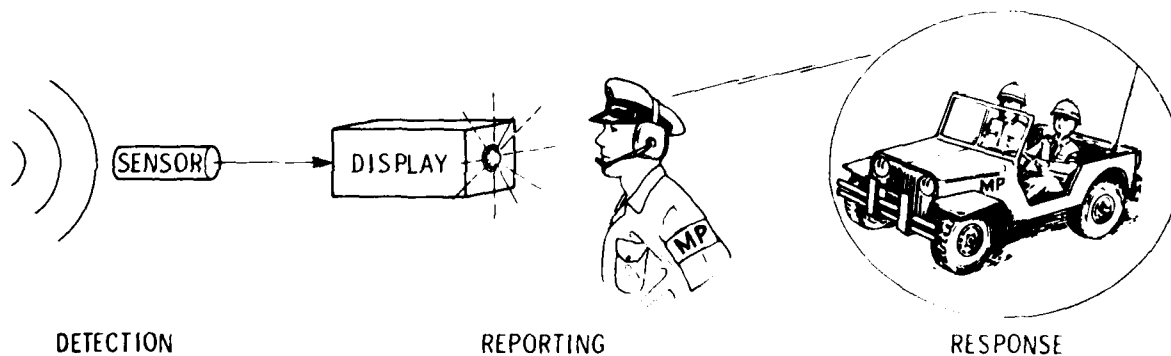DETECTION   REPORTING   RESPONSE

Figure 1. The D-R-R Chain

Returning to the notion that the goal of security is to pose a high probability of interdiction, and that interdiction in modern semi-automated systems depends on a flawless sequence of detection-reporting-response, we can estimate the effectiveness of the overall system in terms of the probability that each component is doing its job:

$$P_{INTERDICTION} = P_{DETECTION} * P_{REPORTING} * P_{RESPONSE}$$

This formulation illustrates dramatically the interdependency of detection, reporting and response (D-R-R) -- lapses in any one component of the sequence will negate the effectiveness of the other two.

Let's examine a few examples of how the D-R-R chain can break down. These examples point out some of the most problematic aspects of current equipment.

The problem of a threatening event not being picked up by a detector in the first place is exemplified by the "blind" spots, narrow lighting range and resolution limits of video assessment cameras, and also by the situation where the intruder chooses a mode of entry which makes it possible to evade sensors. It could be that no sensor was thought of to cover the mode of intrusion, or that sensors have been put in "access" mode, i.e., turned off in conjunction with authorized activities. In general, it is possible to make the probability of detection very high by "wiring" the installation sensitively enough to detect "the drop of a pin." But this leads to false alarms which exacerbate problems further down the D-R-R chain. However, we needn't conclude from this that putting hair-trigger sensors everywhere is a bad idea. They do their part of the job very well.

An example of a reporting deficiency is the situation where a guard is expected to pay unfledging attention to a wall of CCTV monitors for an eight hour shift, and where several months or years may go by between real incidents. What is the probability he will see an intruder cross one of the monitors when it finally happens? Another alarm reporting problem would be illustrated by a screen display system where alarms are reported as alphanumeric codes that have to be looked up in a book to find their location, or where an inflexible pacing of computer interactions stymies the operator's need to quickly ascertain what is going on in an alarm bombardment situation, possibly a coordinated adversary maneuver to attack the installation or to "test" the security system.

In terms of response deficiencies, the number one culprit is a high false alarm rate (FAR). When alarms are pouring in too fast to all be responded to, the probability of response is lowered from 100% down to the actual percentage of alarms that are being responded to. The probability of interdiction can never be greater than this fraction. Hall's previously mentioned study [2] of U.S. Army CONUS sites reported an average false alarm rate of one every 17 minutes. During the 30 worst days of the year, s average was raised to one alarm every six minutes. During the ten worst days of winter, it was one every 3 1/2 minutes. These are average arrival rates - alarms tend to bunch up, so the arrival rate regularly climbs to much higher peaks. Hall did not investigate the rate at which roving patrols could service alarm dispatches, so we cannot directly estimate percentage of alarms answered, but it is interesting to note that in the same study, guards and security managers were asked "Do you feel it would be possible to have a successful penetration of your facility?" 80% of the guards and 88% of the managers answered "Yes." These results support the intuitive conclusion, as well as the more quantitative argument we have been developing, that excessive false alarms can seriously undermine security productivity.

We can summarize our motivation for improvements in the next generation of security systems as the need to redress problems in detection, reporting and response, so that all three functions are performed with near 100% probability. The worst deficiencies in remote detection are the limited purview of cameras, intrusion scenarios not covered by any sensor, and intentional disabling of sensors to prevent authorized activities and weather from causing false alarms. The worst reporting problems are expecting guards to attend to continuous assessment monitors where significant events rarely take place, alarm barrages that cannot be assimilated by the operator quickly enough, and use of slow, obscure alpha-numerics to convey essentially geographic-spatial information. The worst response problem is a FAR which exceeds the alarm response service capacity of dispatched patrols. The remedy is not addition of more bodies to the patrol force -- what is needed is more discriminability between real threats versus nuisance events built into the automated equipment.

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Finally, we need to adopt a total systems approach, aimed at improving the probability of inter-diction above all else, so that the improvements we make in subsystems translate into sound economic investments from the standpoint of overall system productivity.

II. HOW AI CAN HELP

Signal Understanding and Sensory Learning

The techniques and theory of sensory information processing which are emerging from the field of artificial intelligence are directly applicable to the problems of inadequate discrimination and MMI reporting we have been discussing. Briefly, AI is the field of research within computer science that seeks an explanation of how human intelligence works in terms of data processing concepts. In terms of useful ideas that we can apply to multi-sensor security systems right now, there are two areas of AI worth discussing: signal understanding and sensory learning.

Signal understanding is a technique for computing situation assessments directly from multi-sensor inputs. The U.S. Navy and Stanford University scientists demonstrated the feasibility of the signal understanding approach in a system they built called HASP[4]. This system was used for remote surveillance of an ocean region using hydrophones (underwater microphones) as sensors. HASP computed and displayed descriptions of vessel traffic within the region with discriminability several orders of magnitude better than anything previously achieved in multi-sensor processing. Signal understanding systems can describe what is going on near sensors, but they cannot remember what situations they have described in the past.

Sensory Learning is an area currently in the theory development stage at GTE, whose goal is sensory-driven computers which both know what is going on now and which can remember everything from their past, as humans do. This work has barely begun and already it is giving us useful insights into designing better man-machine interfaces and sensor systems whose discriminability grows with age and experience.

In developing the discussion, we won't be able to go into all the details of signal understanding and sensory learning. Rather we will take an applications-oriented approach, i.e., attempt to tie the discussion to security system issues throughout. I specifically want to convey a sense of what is poss-ible in the near future, and to show how AI ideas will influence the "shape" of automated security equip-ment, including ways in which the next generation of equipment can be "padded" to accommodate graceful upgradeability of performance during its lifetime.

How HASP achieves high discriminability

The concept of discriminability in sensor systems is fairly straightforward -- it is simply the number of unique output assessments that can be reported. The simplest case, a sensor with a 1/0 alarm output, provides d=2. A smart sensor with a pattern classifier built in that can discriminate car, truck, bus, plane, and helicopter, plus "no class" (i.e., "don't know") has d=6. The concept of discrim-inability does not say anything about the correctness of these classifications, just how many of them there are. It is difficult to put a figure on the discriminability of the HASP system. Its output consists of text descriptions of ship types, bearings, speeds, ship groupings, as well as underlying evidence for these conclusions stated in terms of sound generating sources like propellers and engine vibrations. The exact situation never repeats twice, and the uniqueness of the situation assessment reports are surely in the billions or higher.

How does HASP work? It is perhaps easiest to explain by comparing how signal understanding differs from pattern recognition. In pattern recognition, the sensor data is preprocessed, then features are extracted from the preprocessed data, then finally a decider selects the classification based on the features. The computation is a straight "left to right" processing as shown in Figure 2a.

In signal understanding, the processing is done at four to five levels, and the processing jumps "back and forth" between levels many times before conclusions are arrived at. Whereas the pattern recognition process computes all the evidence at each level and then passes it up to the next level, the signal understanding process computes "clues," passes them up the next level where they are fitted to a "hunch," and then the process reverts to the lower level to test the hunch by looking for evidence that should be there if the hunch is correct. This style of processing is shown in Figure 2b.

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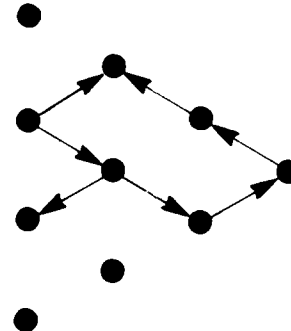Figure 2a.   Pattern Recognition   Figure 2b.   Signal Understanding

Once all supporting evidence has been found for a hunch, it is considered factual. If HASP were part of a physical security system, an example of a fact discovered through this "detective"-like process might be:

fact: truck on road 4

This fact is passed to the next level to see if there is a hunch that can explain the presence of a truck on road 4. Possibly it is part of an authorized maintenance activity. HASP-like systems are smart enough to check out possibilities like this before flagging the truck as a threat. This is precisely how signal understanding systems can reduce false dispatches -- they will first assess signals against every-thing that is known by the system before "blowing the whistle." The knowledge used is extensive, includ-ing knowledge about how a potential threat will register its "signature" on more than one sensor, know-ledge about current weather conditions and how their effects can be discriminated out, knowledge about routine authorized activities and their effects on sensors. It is because of all this knowledge, and because of its ability to form hunches and run them down before having to decide what is going on, that a signal understanding system is "intelligent" compared to an alarm reporting system based on dumb sensors or pattern classification.

Reporting in a signal understanding system differs markedly from an alarm system. With the automatic assessment capability conferred by its knowledge and processing, reports are not alarms, but "situation assessments," or descriptive statements of what is going on. Examples of these would be "gust of wind occurred" and "jet plane overhead" displayed on the operator's console display. Only assessments with highly reliable supporting evidence are presented this way. The remainder of detected phenomena are reported, to the extent partial assessment is obtained, as things like "unauthorized vehicle," "unauthor-ized personnel," or simply "unexplained phenomenon." These are the true "alarm" reports which warrant immediate dispatch patrol investigation. Partial assessments can benefit response force preparedness significantly over merely dispatching to unqualified alarms.

The HASP system required about 10 man-years of effort to build, and required a large capacity computer. It is generally accepted that the cost of replicating systems like HASP is reduced with each successive implementation, although a floor of 5 man-years probably cannot be undercut for a large AI project. Even at this cost, signal understanding has potential for payback over a system lifecycle by reducing the false alarm rate, and thereby reducing the level of staffing for response patrol units. The know-how and software tools needed to apply AI signal understanding to security systems exist today.

How learning keeps discriminability growing

Even with an automatic situation assessment capability, there will still be false alarms that are not "trapped" by the system. These will result from new and unanticipated nuisance phenomena. A swarm of june bugs decends on the site and sets off acoustic devices inadvertently when flying too close to them. A nearby rancher decides to drill a well causing seismic alarms to trip on the base. The world is full of surprises in this regard -- however, there is no reason why security personnel should have to

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live with these annoying and demoralizing nuisances, and they won't have to so long as the system has a built in mechanism for learning. Learning is any automated, or semi-automated process for adding new knowledge to the system, in this case, knowledge about new nuisance phenomena. This concept, which can be easily married to the HASP-like signal understanding approach, is a direct outgrowth of GTE's sensory learning project.

Figure 3 illustrates the basic concept of sensory learning. Any time an alarm is tripped, automatic assessment via signal understanding is initiated. If the clues computed from data collected at the alarming sensor and its neighbors cannot be explained in terms of a known phenomenon, two things happen. First, an "unassessed phenomena" report signals the security console operator to immediately dispatch troops to the location. At the same time, the system stores as much evidence as possible, mostly extracted features and raw data, picked up from the primary sensor and sensors in the vicinity of the alarm just as it was being triggered. Finally, a radioed-back assessment of the cause of the alarm from the response unit, if ascertained, is entered into the computer and linked to the raw, sensory evidence collected. These two chunks of information are sufficient for purposes of creating the new knowledge needed to automatically trap future occurrences of the same nuisance.

In fact, we can think of this same learning process as being responsible for the creation of all of the sensory interpretation capability that has ever been built into a security system, except that in the past this process has been done slowly and manually. Whereas, the traditional approach has been to send an engineer with an instrument to the site to gather nuisance "signatures" to be built into discrimination equipment, sensory learning automatically gathers the same information using the system's remote sensors as the "instruments," and the human judgment of response patrol officers about why readings were registered, in place of the engineer's.

When initially fielded, the learning security system has no knowledge and a high FAR. As it ages, it acquires knowledge directly from the sensory environment, i.e., it learns the nuisance-generating idiosyncrasies of the site in which it is fielded. To the extent these nuisance stimuli can be "staged", or reenacted during the first month or so of operation, the security system can be quickly taught about its environment by contractor and security personnel. Figure 4 depicts the impact of sensor processing technology on FAR.

The automatic sensory learning concept gives roving patrol units a new and important role in the security system equation -- if they cannot return with an apprehended suspect, they can return information valuable for weeding out subsequent false alarms. Thus, the job of answering alarm dispatches contributes directly to productivity-boosting objectives whether or not an intrusion has taken place! We can predict that as the guards begin to understand the power this feature gives them over their job, i.e., they can directly lower the incidence of false alarms by getting to the scene quick enough to identify the nuisance phenomena and radio it back, they will experience a boost in morale due to increased control over their job and the environment they are charged with protecting.

In part III of this paper, we will describe the computer systems architecture needed to implement a learning security system, and will describe how existing sensors can be retrofitted to extend their role beyond mere detection to automatic alarm assessment and learning.

To summarize, AI signal understanding techniques which have successfully emerged from the experimental stage are ripe for application to the problems of large, multi-sensor security networks. The most outstanding benefits are higher discriminability between nuisance and legitimately threatening events, more informative reporting to the console operator, and significant reduction of false dispatches. The power of signal understanding can be extended by formally acknowledging the requirement to learn about new types of nuisance alarms as they arise, i.e., sensory learning. This feature provides still increased leverage over false alarms, and gives mobile response troops a new, meaningful role as information gatherers. This contribution can be translated directly into improved system performance, and thus can feed back into the guards' self-esteem, their sense of being in control of the security equipment rather than vice versa, and a direct perceivable link between assigned duties and security objectives.

Job Design for the Next Generation of Security Console Operators

Now we turn our attention to the topic of how AI concepts can be applied to remedy reporting problems at the man-machine interface (MMI). We have already mentioned one benefit -- the display of situation assessments instead of unfiltered alarms allows the operator to stay more informed about what is going on out on the site. Before launching into a more thorough treatment of the MMI issue, we need to discuss some of the manpower objectives this interface should be designed to accommodate in the coming years.
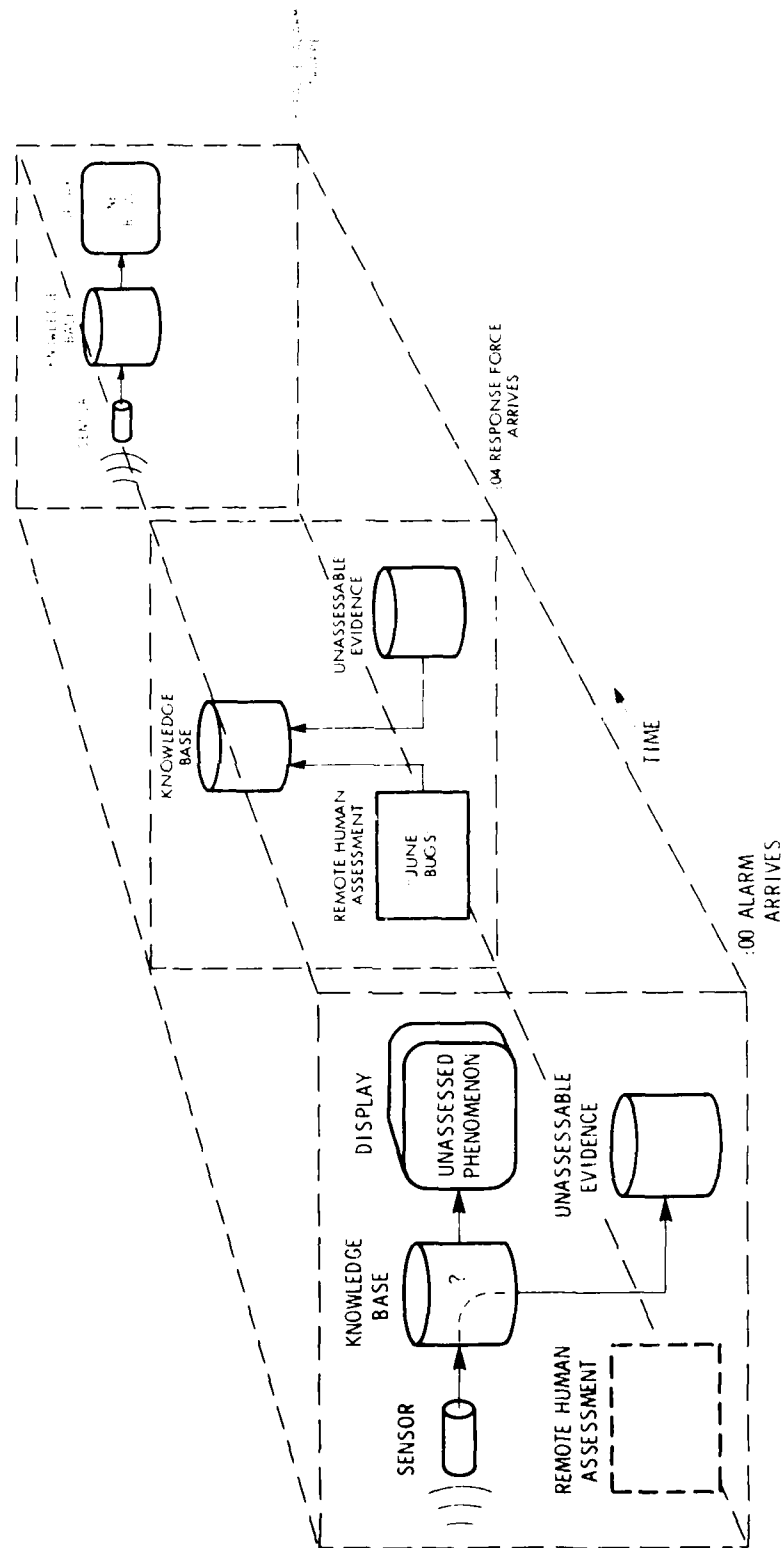
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Figure 3. Sensory Learning Concept Applied to Security Systems

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DUMB SENSORS

PATTERN
RECOGNITION

SIGNAL
UNDERSTANDING
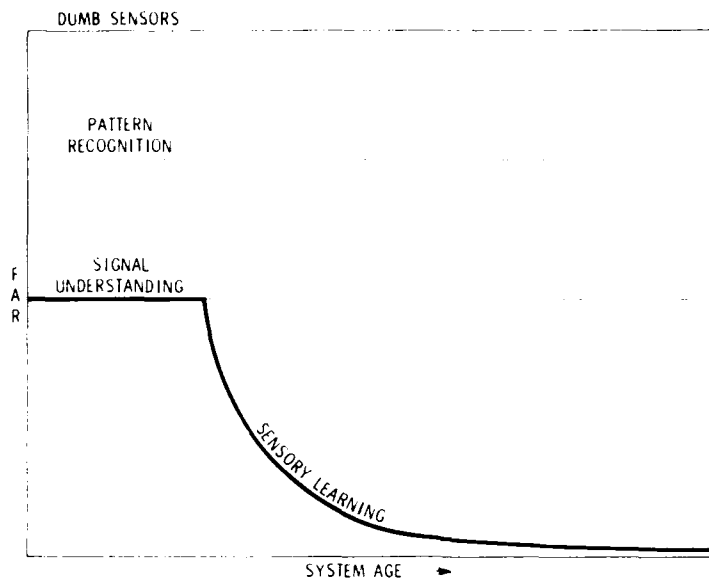
F
A
R

SENSORY LEARNING

SYSTEM AGE ➤

Figure 4. Impact of Sensor Processing Technology on FAR

Attrition has been harped on consistantly as a recurring problem in previous symposia. We need to keep the turnover problem foremost in mind when talking about MMIs, because MMI design is also human job design. The theme chosen for this year's symposium, The Human Element, has been grossly overlooked in the design of computer-human interfaces. And I'm not talking about screen glare, tilt angles and chair heights, but rather the much more unwiedly and deep-seated issue of the form and content of what gets presented on the screen, how the operator can control what gets put on the screen, and what the things shown on the screen mean to the operator. We need to more fully address these issues in the next generation of equipment.

Lack of career advancement potential was cited by Hall as the reason most often given by security guards for their departure. Boredom was a close second. The 147 U.S. Army guards sampled were asked to define their career objectives. The three top choices given were law enforcement, civilian occupation and college, in that order. Together, these three career paths represent 76% of the responses -- all other categories drew less than 6%.

Besides doing whatever we can to make the job more interesting and compatible with long-range skill development, we need to insure that when turnover does occur, critical knowledge stays behind with the system. If we cannot stop turnover, at least we can minimize its impact.

We also need to observe that a demographic "trough" in the age bracket out of which guards are traditionally drawn will make recruitment more competitive for the next twenty years or so. We must assume modest requirements for operator education level, i.e., high school plus one or two years of college or service training. Of encouragement, the 15-year-long drop in SAT scores has finally reversed and begun to swing back upward.

It pays to observe the wide appeal for video games that the next generation of console operators will bring with them to the job. We need to find ways to tap that enthusiasm, for instance by choosing vivid, high-resolution, moving color graphics to report security status, as opposed to staid alphanumeric text reporting, and by exploiting input devices such as joysticks and trackballs with which this generation has already developed considerable eye-hand coordination.

Finally, we must address the alarm bombardment problem. How can reporting be designed so that, even in the event of a multi-agent, coordinated, full-scale attack, the proper response is quickly initiated without operator panic?

To summarize the job design obectives for the next generation security console operator's job, the design should take a strong human factors approach to information content and meaning passed across the display, should concentrate on acceptability to a pool of users more accustomed to getting information from TV and video than from books and reading, and should regulate operator stress to a moderate level,

by avoiding the extremes of overload and panic on the one hand, and abject boredom on the other. GTE has coined the term operator stress leveling, or OSL, for this objective. Finally, the job design should include avenues for on-the-job, career-advancement-oriented learning.

How AI Can Improve the Security Console Operator's Job

Signal understanding technology has the potential to make two significant contributions to a better engineered MMI, beyond those already mentioned concerning the reporting of situation assessments and drastic reduction of false alarms.

The first benefit concerns alarm bombardment. Because of the feature in a signal understanding system that allows phenomena to be defined in terms of underlying evidence, at any arbitrary level of abstraction, it is possible to "program" a hunch of a coordinated attack, which gets triggered when more than two or three unexplained phenomena crop up in narrow temporal or spatial vicinities. When this happens, instead of reporting individual incidents, the hypothesis of an invasion is flashed. This allows the operator to alert backup forces immediately, instead of wasting precious time interacting with the computer over each separate incident in a serial fashion. It also permits different invasion scenarios to be discriminated, such as "invasion by air," "invasion by foot," and "vehicular invasion." Situation assessment reports such as this foster additional preparedness of the engaging response forces in meeting the attack.

The other benefit comes from the fact that, for any assessment displayed on the screen, the user can ask the system "Why did you come to that conclusion?," and the system will pull out and display the underlying evidence on which the conclusion was based, as well as the hunches that were called into play. This feature is called transparency. This capability gives the user a chance to trace mistaken conclusions to faulty hunch definitions, so that they can be corrected. Transparency brings all of the knowledge contained in the system selectively into direct view of the user if desired. Transparent operation has been found to be a critical factor in building human confidence in machine-computed assessments. The ability to answer the question "Why was something concluded?" is central to this process.

Unfortunately, signal understanding's biggest short coming at present is in the area of the human interface. So far, assessments and their supportive evidence have only been able to be presented as unformatted lists of words and numbers on an alphanumeric terminal. People are working on the problem of making these assessments more human consumable, including more use of graphics. This may prove difficult approached as an afterthought.

The sensory learning theory being developed at GTE approaches the problem of rich, pictographic communication head on. The ultimate goal of the project is a computer interface based exclusively on moving pictures and sound. This computer will communicate like "HAL" in th movie 2001, i.e., it sees and hears the user through a camera and microphone, and a shared video screen is under the control of both man and machine. While we are a good ten years away from building this machine, the theory of how it works can already be applied to the topic of today's MMIs. Interestingly enough, the theory is receiver-oriented, so in discussing today's interface problems, the analysis focuses on the human as a sensory learner, rather than on the display itself. This is significant, because almost all of the past work on MMI has focused on the terminal, i.e., the source, not the receiver.

Let me give you a for-instance. In sensory learning theory, an unchanging image on the retina has no meaningful information content except when it first started and again when it ends, i.e., information content is clustered around points of change and unpredictability. Now suppose the eye is watching a CRT display with the message "ALARM IN SECTOR B" displayed on it.

Traditional thinking views the information as that which is on the screen. But from the sensory learning point of view, there was only information on the screen when the message first appeared. So long as the message remains on the screen and the viewer remains affixed to it, no information is being transmitted. When it finally disappears and the screen goes blank, information is again being received, but only for the short duration about the change.

If we apply this same thinking to the case of continuous video assessment monitoring, we can immediately see the problem -- there is usually no information coming from the tube. Since humans are sensory learners, and this species of information processors likes to keep a fairly steady flow of information coming in, they will instinctively avoid regions of the visual environment that show no change. Thus, asking a guard to watch a CCTV monitor for eight hours is barely distinct from asking him to stare at a blank wall for his entire shift. There is no way you can get him to do it. Meanwhile, to the engineer who brought in the video equipment, and the shift supervisor who makes the rounds, and tells the

guard to keep his eye peeled to the tube, when they look at the monitor it does transmit information. This is because they do not watch it very long, i.e., their job design allows them to keep collecting information.

Needless to say, we are just beginning to understand this new, receiver-oriented sense of the word "information." It has great intuitive appeal, once you get familiar with thinking that way. What we have learned so far from our sensory learning theory is that we have probably been building man-machine interfaces all wrong since we began building them. For instance, sensory learning suggests that a good interface display should be almost constantly changing, should contain a fairly even mix of novelty and redundancy, or pattern, and should take into account the user's prior sensory experience, both at the display and away from it, in determining what is novel versus what is redundant, i.e., the output should be highly customized.

This new view of the MMI world immediately suggests that we should be doing things like providing videotape playback facilities on our consoles so that the operator can tune into training video tapes to learn about accounting, electronics, law-enforcement or whatever else he wishes, during working hours, with the security status display poised to cut in automatically whenever trouble brews, and cut back out again after things settle back down.

Another idea that is a direct spin-off of the sensory learning program speaks to the design of the security status displays themselves. Whenever possible, we should use literal and realistic portrayals (versus symbolic and representational) of the thing you want to convey. Figure 5 shows an example of a well-engineered display for reporting automatic assessments. The area under surveillance (a "module" of MX dense-pack which enjoyed short-lived popularity) is portrayed using 3-dimensional projective geometry, as if the operator were directly viewing the site from the air.
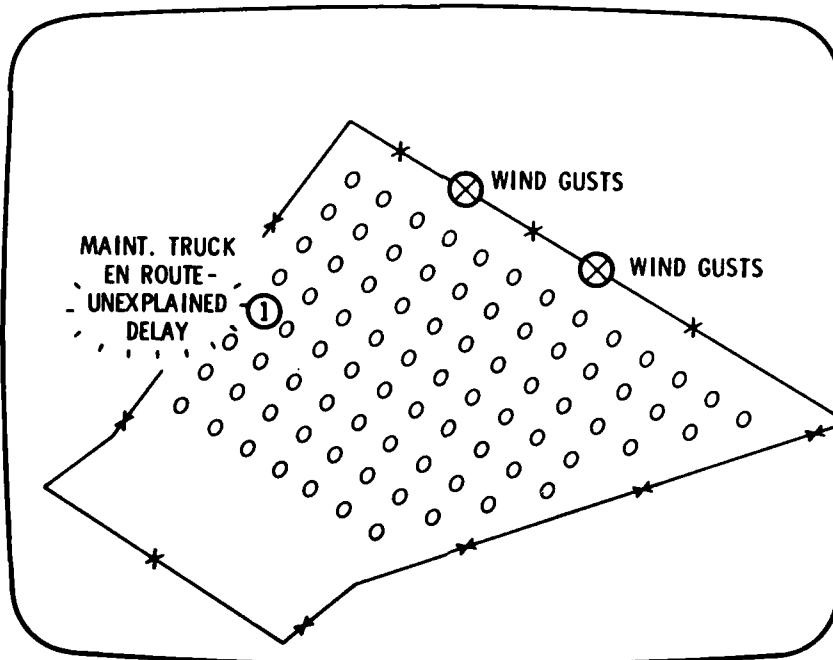

Figure 5. Example of Automatic Situation Assessment Reporting Display

As previously mentioned in the discussion about using sensory learning in the security equipment itself as a technique to weed out false alarms, the console operator has a dispatch follow-up function to perform, namely, entering human assessments of why an alarm went off radioed back from the field. This work directly benefits the operator in that, by doing it, he can reduce false alarm interruptions of his other on-the-job pursuits. Since it also benefits roving guards upon whom he is depending for on-the-scene assessments, a highly cooperative relationship between dispatcher and patrols is likely.

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As a final note, sensory learning theory suggests that video assessment based on a large number of fixed position cameras may be intrinsically an informationally impoverished approach, even when used only after an alarm has gone off. A much better approach from the standpoint of receiver-oriented information flow would be to use only a few video cameras, but to mount them on highly mobile vehicles such as RPV helicopters and ground robots that can quickly zero in on the target area, look around, and position themselves for the best view if activities are spotted.

We are very excited about the insights we are gaining from our early involvement with sensory learning. Obviously, we want very much for this research to continue -- as far as we know, there is no other research like this going on anywhere else in the world at the present time.

Let us now summarize the potential benefits of AI to the next-generation-system operator console. If awkward interaction formats can be overcome, signal understanding systems can support stress-reducing measures for reporting major, orchestrated invasions, and transparency, or the ability to look at and fine tune evidential processing within the automatic assessment software. Sensory learning theory, a receiver-oriented approach to richly informational audio-visual communication, seeks to eventually replace keyboard-stroke computer entry with intelligent machine vision and hearing. In the meantime, the theory can be applied positively to MMI job design by defining information from the receiver's point of view, and by allowing continuous information reception as a normal working condition. This philosophy rules out making people watch TV images where nothing is happening, and encourages on-the-job educational enrichment mixed with highly-informational security status displays which interrupt as needed.

III. THE CHANGING SHAPE OF FUTURE SYSTEMS

This last section recapitulates the major ideas so far covered, in terms of the way they will influence security system architecture and personnel requirements.

The change that seems the most inevitable is the continued substitution of fixed cost, productivity-stretching equipment in place of human security workers who cost more and more to employ each year. This change will be marked by increasing equipment sophistication, especially concentrated in computer hardware, software, and displays. The focus of these equipment enhancements will be improved ability to automatically discriminate benign versus suspicious events falling within the surveillance of remote sensors, i.e., false alarm reduction. These upgrades will improve security efficiency, both qualitatively in terms of lower perceived vulnerability, and quantitatively in terms of fewer response troops required to investigate fewer alarms in a given territory.

The inroads made in discriminability will be due to increased processing software complexity. There is no getting around this fundamental proportionality -- more discriminability always requires more knowledge.

In order to perform automatic situation assessments efficiently enough to be useful in capturing quick moving intruders, HASP-inspired signal understanding approaches will require a big central security computer with large virtual address space, and a distributed network of microprocessors branching out to the sensors. The communication channels linking these elements will have to support two way, low bit-error rate, high bandwidth traffic. Maximum outbound data rates are encountered when downloading infrequently used feature-extraction algorithms to the micros. Maximum inbound traffic occurs when raw sensor data is being collected for learning purposes.

The undertaking of a HASP sized software project will require a minimum of five man-years of effort involving a cooperative effort among AI-trained computer scientists, systems engineers, sensor experts and career security personnel.

Almost any type of sensor can be used in this approach, from door closure switches to wideband ground surveillance radar, so long as adequate data transmission channel space is reserved. Figure 6 shows how existing sensors, including those already including some "smart" processing, need to be reconfigured for use in an automatic assessment plus learning security system. As indicated, for each type of output the sensor can produce, starting with a 1/0 alarm bit, there is a less massaged, more unprocessed "backup" output. The intent of this design is not to discourage sensor engineers from working on discrimination processing -- it is more to assure that the discrimination problems they leave unsolved will be able to be solved by someone else. The lesson of signal understanding is that individual sensors do not have to figure out what is going on in order for the system as a whole to figure it out.
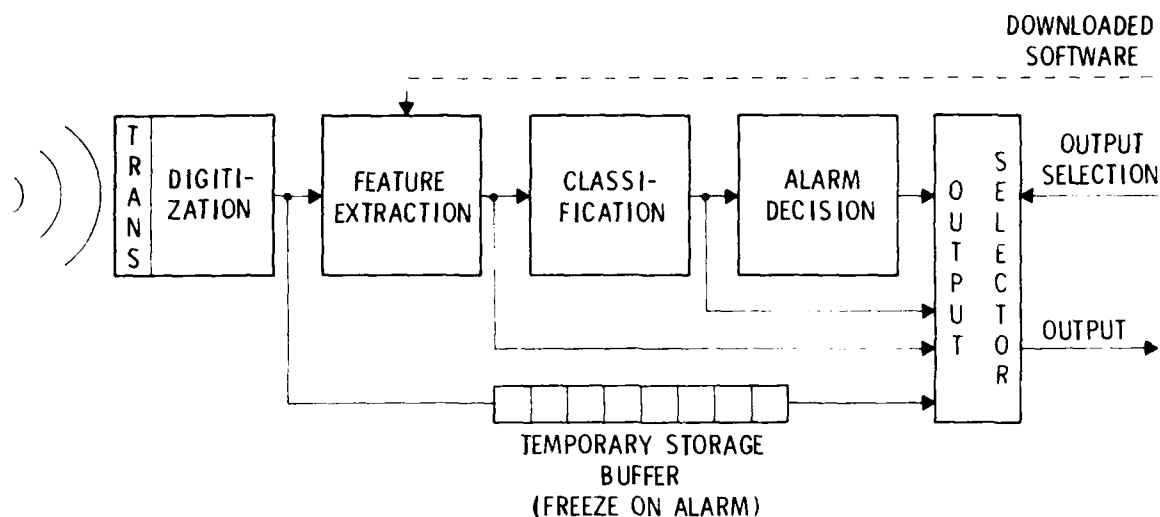
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       DOWNLOADED
        SOFTWARE
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Figure 6. Versatile Output Smart Sensor

Reliability Is a major concern. If It gets around that the security computer Is down alot, and this
condition is testable from an outsider's perspective, the objective of high-deterrence security has been
sacrificed. One of the pluses of multisensor signal understanding is its natural anti-spoofing quality.
Because of the complex interaction of overlapping sensors, and the non-deterministic manner in which
evidence is gathered and sifted, the stimulus-response behavior of the system is not simple enough for an
outsider to be able to figure out an easy way to fool it.

In terms of changes visible in the main security console room of future systems, we can expect more
sophisticated reporting, fewer panels of blinking lights, and more CRT usage in presenting information.
As assessment automation progresses, more territory will be able to be protected from the operator's
chair. As the console job becomes more information-intensive, better response resource allocation deci-
sions will be made possible. The operator's judgment will still be a critical factor, however he will
Increasingly be offered the chance to embody his judgment in the system as a lasting mark of this contri-
bution. Also, he will be encouraged to stay busy and make good use of his time while on duty, as his
security job becomes more one of exception-handling than constant vigilence, as it was back in the days
of high FARs. Finally, as man-machine interface technology advances, he will more and more be the focal
point toward which a highly customized and selectable information product is directed. The result will
be both excellent security protection and a self-actualizing individual.

In future systems, roving patrols will be able to exercise more control over their job by actively
participating in the elimination of troublesome nuisance alarms. There will be fewer guards per square
mile, and more confidence about invulnerability than exists today.

IV. SUMMARY

We have studied the motivation for the next round of improvements in semi-automated security,
including more control over territory, more territory under control, containment of escalating personnel
costs, and more humanistic, self-fulfilling job design.

Two areas of current AI activity, signal understanding and sensory learning, have been singled out
as having the potential for productivity-enriching applications in the security world in the near term.
The biggest payoff from both technologies will be to systematically eliminate the rash of false alarms
that currently plague automated equipment. Beyond this, sensory learning AI concepts promise to
significantly improve the "informational" workspace of the security console operator. Once these

improvements have been implemented, security workers will find a much more harmonious relationship with the equipment they depend on, and will be able to turn their attention to the assimilation of career building skills and information.

AI is certain to play a key role, both now and later, in the attainment of these milestones.

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SECURITY SYSTEM OPERATIONAL RECORDING AND ANALYSIS
(SSORA)

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FACTORS
RESEARCH**

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SECURITY SYSTEM OPERATIONAL RECORDING AND ANALYSIS
(SSORA)

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INTRODUCTION

The functions of a security system whose operational objective is to minimize the likelihood of destruction or theft of high-valued material include surveillance of the protected area; early detection of unauthorized intrusions to the area; differentiation between system alarms caused by potential threats versus nuisance sources; rapid localization of all potential threats; interdiction and neutralization (or containment) of the threat; and apprehension of the intruders.

Today these functions are being accomplished with increasingly sophisticated and effective man-machine systems. Large investments are being made in automatic sensors and Closed Circuit Television monitoring systems in the interest of maximizing the surveillance, detection, identification and localization capabilities of security systems. Many of these developments reflect recognition of human frailties in performing the surveillance function. Vigilance researchers have long known that the alertness level of human operators performing a tedious repetitive surveillance task progressively declines, especially if the task is characterized by low probability of occurance of a significant event as opposed to a relatively high probability of nonsignificant events. It does not seem to matter whether the potential critical event is life threatening or not. In fact, the results of vigilance research generally suggest that the probability that security system personnel will detect a signal of interest (signal is broadly defined here as any indication of a critical event) is a direct function of the probability that such a signal will occur. Of course, in most of the surveillance systems with which we are concerned the probability of such a signal approaches zero and, in the routine everyday experience of security personnel, it has been learned that that probability is very low indeed. It is for this reason that automatic sensing devices are a necessary component of an effective security system. Experience shows however, that automatic sensors are unlikely to completely solve the problem of detecting all critical events in a timely manner.

Analysis of upgraded security systems shows that although many of the mundane tasks earlier performed by humans in the system are now performed by automatic mechanisms, the criticality of mans' role in total system functioning has actually increased rather than diminished by virtue of these technological advances. We will use as our example a security system at a nuclear Weapon Storage Area (WSA) which has automatic sensing devices around the site perimeter, both in the ground and on the perimeter fence, and whose signals are displayed visually and aurally in a Master Surveillance Control

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Facility (MSCF) manned by one or more operators depending on the size of the installation. In addition to the alarms provided by the sensor system, Closed Circuit Television (CCTV) imagery is automatically displayed of any sector that is alarmed so that a CCTV image of the affected area is available for the operator's inspection. In addition to the CCTV imagery the operator has visual surveillance from his location in an observational tower. The MSCF Operator (MSCFO) is backed up by other personnel in Central Security Control (CSC) who also have a visual display showing the general location of the alarm source. The MSCFO and the CSC personnel have at their disposal mobile patrol units that can be dispatched to quickly investigate the source of any alarm, and, if the source is unauthorized or threatening, to perform appropriate interdiction and apprehension. These patrol personnel are backed up by Alert Fire Teams (AFT) who, within minutes, are able to bring additional personnel and considerable fire power to bear on a threatening situation.

THE PURPOSE OF SSORA

The question is, how well do such security systems work on a routine daily basis when no real threat is expected? How does one go about determining how well the system works? How does one measure the performance effectiveness of the system and what should those measures be? Are there unrecognized system deficiencies? If so, how can they be corrected? How can the human element in the system be made to perform optimally? How can a high level of performance be sustained?

The SSORA system was designed to answer these and related questions about security operations. At the time of its conceptualization there was no objective way to determine system effectiveness during routine operations. Consequently there was no basis for assessing how well or poorly personnel in the system were performing their job, no basis for providing objective feedback or meaningful reinforcement for good performance and no way to realistically exercise many of the tasks that the security personnel had been trained to perform. These conditions, coupled with a low expectancy on the part of system personnel that a valid alarm will be experienced (that is, that activation of a sensor will be from an intruder rather than a nuisance source) would lead to the prediction that the human components of the system were unlikely, for long, to maintain a high state of responsiveness.

The SSORA system provides a means for overcoming these problems by performing five essential functions:

1. It stimulates the security system (i.e., provides actual intrusions by simulated adversaries)

2. It records all system responses (alarms, CCTV imagery, communications among security team members, search behavior, tactical deployment, decisions, outcomes)

3. It measures response effectiveness in terms of such objective indices as response times, errors, successes

4. It provides a means for diagnosing the reasons for delayed responses to a signal, failures to detect an adversary, and command and control errors in response to an identified threat.

5.   It provides a means for feeding back performance effectiveness information to system personnel and an objective basis for rewarding good performance and correcting or compensating for system deficiencies.

How SSORA accomplishes each of these functions will now be described in greater detail.

System Stimulation

A fundamental premise of the SSORA system is that security personnel must be given the opportunity to experience valid alarms. Clearly, routine daily operations do not provide this opportunity; in fact, the vast majority of alarms are generated either by known authorized sources or by "nuisance" sources whose origin may or may not be fully identifiable. Examples of the latter include sensor activation by strong winds, animals, electromagnetic sources and so forth. The consequence of this is a high expectancy for false alarms and a low expectancy for valid ones. Therefore, the SSORA team engages in simulated penetrations of the site perimeter and deliberately generates "valid" alarms.

The SSORA team consists of 1) an exercise controller; 2) a video camera operator who records the intrusion and security team responses to it from an external observation post; and 3) one or more "intruder(s)" who simulate penetration at the fence line. In no case is the fence actually breached although the intruder engages in activities that simulate cutting or climbing the fence.

Depending upon the scenario, one or several alarms may be generated. All exercises are run at unannounced times and locations, although the site's security personnel are necessarily briefed ahead of time that such exercises will be conducted. Exercises are conducted on an around-the-clock basis, typically over a period of about 10 days. The number of simulated penetrations per shift typically ranges from 0 to 3.

Following acknowledgement of the alarm by the MSCFO all subsequent communications among security team members and all actions/decisions are recorded by the SSORA system. If detection of the intruder occurs, the exercise scenario is continued through simulation of a number of likely subsequent actions on the part of the intruder(s). These actions may include, for example, the observation that terrorists have been seen running toward a particular secure structure. These actions are not actually performed (for reasons of personnel safety) but are simulated by messages transmitted by radio to the MSCFO by the exercise controller. The messages are displayed on a CRT in the MSCF. The scenario confronts the MSCFO with the need to make a variety of tactical decisions concerning the dispatch and allocation of his resources, that is, the investigative patrols, back up AFT, and so forth. Any desired level of exercise complexity can be introduced in the scenario although care is taken to ensure that the simulated terrorist activity is reasonable from the standpoint of the time and location of the initial simulated penetration.

Each exercise scenario, when carried out completely, provides the opportunity to test the security system in terms of all of its major functions: Detection of the intrusion, identification of the alarm as a potential threat rather than nuisance, search and localization by area patrols, command and control of resources, tactical deployment, and appropriate behavior related to interdiction, apprehension, or neutralization.

Recording of System Responses

The SSORA system records security system responses to simulated threat scenarios in two ways:

1) All sensor inputs, control responses to those signals, and all closed-circuit TV presentations are recorded on a digital tape recorder for subsequent playback and analysis. Similarly, all communications between the MSCFO and other members of the security team are recorded, whether these occur by radio, telephone, or direct voice.

2) Recordings of the behavior of security patrols and the AFT to directives from the MSCFO or other security personnel are recorded by means a TV camera located in an advantageous position outside the site perimeter. For example, the behavior of patrols attempting to locate the intruder, who uses as much cover and concealment as possible, is recorded for subsequent evaluation in regard not only to success in detection and localization but with respect to appropriateness of the tactics used as well. In addition, the exercise controller can enter miscellaneous observations concerning significant aspects of behavior or other events by means of a hand-held terminal which is used to transmit these observations to the SSORA base station and into the data multiplexer for storage and subsequent analysis. (See Figure 1).

In addition to the sensor, communication, and behavioral data, all of which are recorded on a common time base, we have found it useful to record weather data, which may, at times, influence system response. For example, wind speed and direction, humidity, and precipitation can be recorded as well as changes in these variables. Experience has shown that weather factors can influence false alarm rate, clarity of the CCTV imagery, likelihood of visual detection of the intruder and so forth. The weather data also are automatically entered into the data multiplexer for subsequent analysis.

System Effectiveness Measures

The measures of system effectiveness generated by the SSORA system fall into two broad categories related to: 1) detection/identification functions, 2) and command/control functions. The former categories include such measures as:

1. Time, location, and number of alarms presented to the MSCFO

2. Alarm failures or delays
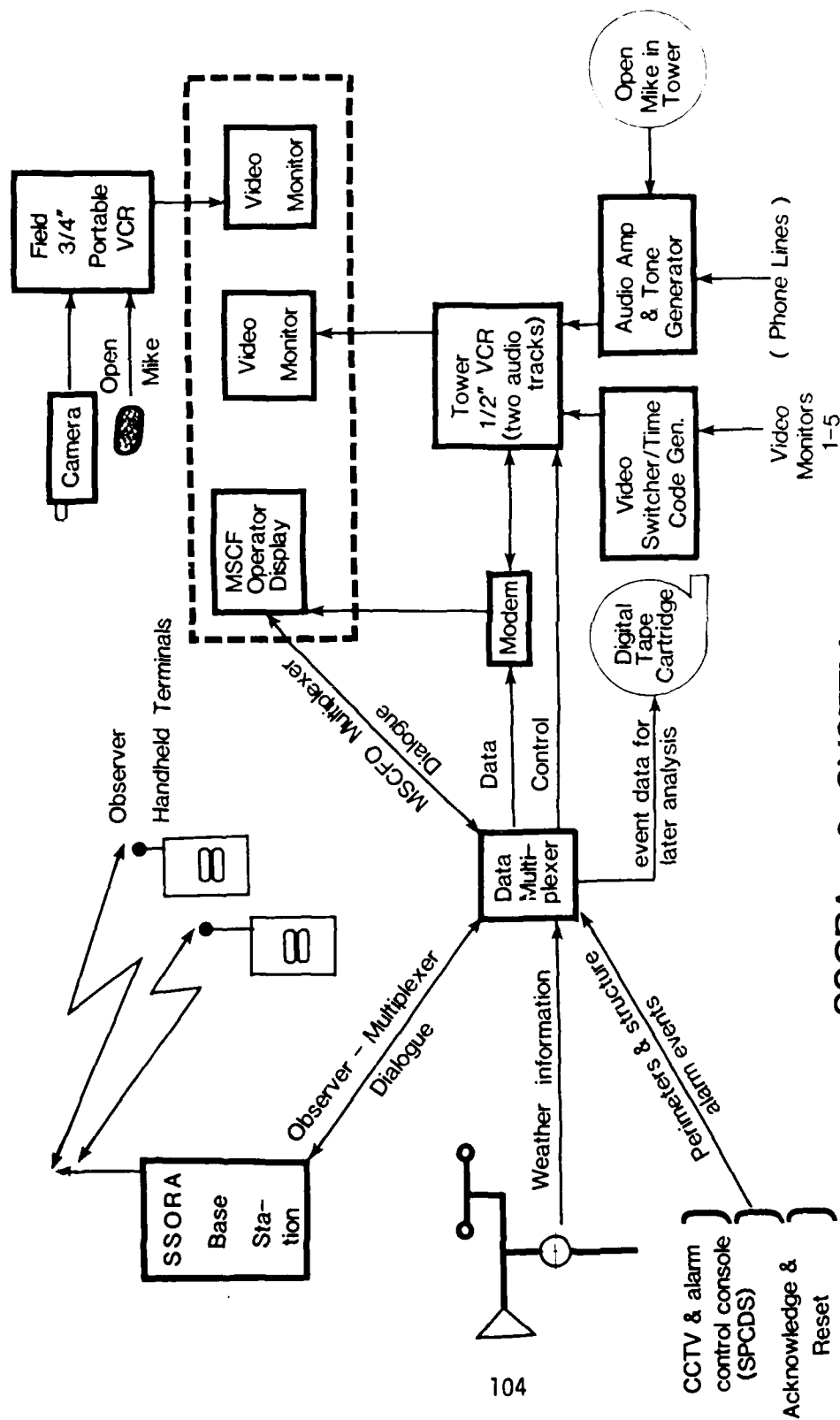
SSORA – 2 SYSTEM

Figure 1.

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3.   Delay time in alarm acknowledgement

4.   System reset time

5.   Automatic activation of CCTV monitor displays

6.   Operator activation of selected TV monitors

7.   Delay time in detecting a signal by the MSCFO

8.   Degree of success by the MSCFO in identifying intruder presence

9.   Dismissal of a valid alarm by the MSCFO

10. Time spent by patrol teams searching for a suspected intruder

11. Detection success or failure by the patrol team

Under the heading of Command and Control the following types of measures are obtainable:

1.   Decision time in ordering a patrol team to investigate

2.   Effectiveness of directions given to the patrol team for intruder localization

3.   Decision time to allocate additional resources (other patrols or AFT) in response to a developing scenario

4.   Fire-team response times

5.   Tactical errors

6.   Communications effectiveness, discipline

7.   Team coordination

It is emphasized that the majority of these measures of effectiveness are highly objective. Response times, detection successes, failures and delays, apprehension of the intruders and communications effectiveness are elements of system performance about which there is little argument when the exercise events are played back on a TV display during post analysis. We ourselves are not tactical experts and have made no attempt to assess the appropriateness of the tactical behavior although this is clearly within the capability afforded by SSORA system recordings.

Diagnosis of System Problems

To date, we have conducted a total of 141 simulated penetrations at 5 military installations in the U.S. and Europe. In the great majority of cases the sensor equipment and guard personnel effectively handled these intrusions, but there have been some cases of inordinate delays in responding to the threat and a few cases of outright detection failure. When failures occur, there is a natural tendency to blame the humans in the system. However, we

have found that failures are rarely, if ever, solely the result of human performance deficiencies. Rather, detection and identification problems almost always involve some combination of human, equipment, environmental, and procedural deficiencies. We have found for example, that some system operators had no experience in recognizing the type of image that may be presented on a CCTV monitor by an intruder who is taking full advantage of available cover and concealment opportunities. We have sometimes found camera misalignments that worked to the intruder's advantage. We have shown that the advantage given to an intruder by even small amounts of erosion or vegetation at the fence line can be sufficient to preclude or delay his detection, even in daylight. We have shown that visual search procedures have sometimes been far too casual because of the assumption by security personnel that a real intruder was unlikely to be present, and, if he were, that he would readily be detectable. We have shown that security team members have at times insufficiently appreciated each other's operational limitations, with the result that each erroneously thought the other was in a better position to determine if an alarm were valid than he really was. We have shown that low expectancy for an actual intrusion affects behavior in a variety of ways that may cause security personnel to prematurely dismiss ambiguous indications from the sensor and display systems.

Post-exercise analysis of the signals that were generated by the system, of the imagery that was available to the operator, of the communications that took place between various team members, of the decisions that were made to investigate, to dispatch resources, or dismiss alarms as coming from a nuisance source, enable us to sort out the human, equipment, environmental and procedural factors that determine the level of success in coping with each scenario. Once the error sources have been identified, we have found that they can be readily corrected or compensated for by the security personnel.

Feedback of Effectiveness Data

The original SSORA objective was to develop a means by which the performance of security system personnel might be assessed in the interest of sustaining a high level of security system effectiveness. A fundamental tenet of behavioral science is that performance feedback and reward for good performance are essential to sustaining high level performance, especially in the case of tedious tasks that are not intrinsically rewarding. Fundamentally, the SSORA system is a feedback system and the impact of that feedback on security system personnel to date has been pronounced if not dramatic.

To accomplish feedback, SSORA exercise recordings are used to construct video tapes that summarize key events from the scenarios conducted at each site. The intrusion, the alarms, and the security team's responses are captured for post-exercise review. Playback of these tapes clearly pinpoints critical behavior related to the detection, identification, localization, and apprehension of the intruder. System softspots, errors of procedure, misinterpretations, and inappropriate expectations become clearly evident to security personnel who see and hear themselves in action. These personnel are sometimes incredulous at the problems that are portrayed. Most important, however, they quickly learn from their own experience and that of others not only about procedural and interpretative errors, but about system softspots associated with the equipment and/or environment for which they must

compensate. Return visits to bases where such feedback has been given have shown dramatic changes in the search behavior of security personnel in response to a potential threat signal, significant improvements in the calibration and alignment of surveillance equipment, and far greater attention to environmental conditions that might aid a potential adversary. Further, the reactions of security personnel to SSORA feedback sessions is almost uniformly positive. They enjoy the opportunities that SSORA procedures give them to actually do their job, exercise their skills, and gain recognition for a job well done. Thus, the motivational impact of the system is highly favorable, in addition to its assessment, diagnostic, and training capabilities.

DISCUSSION

In earlier studies of security system effectiveness it has been observed that the lack of visible performance output seriously limits the opportunities to reinforce and sustain desired guard behavior in a realistic fashion (see Hall 1979, 1980; Hall and Mackie, 1981). Results from SSORA data collections suggest that lack of system performance feedback has also been a handicap to the maintenance of security system equipment, to inspection and assessment procedures that are operationally meaningful, and to the planning and design of new security systems. Prior to implementing decisions about the effectiveness of unit performance, the design of new equipment, and the modification of procedures, the decision maker should be confident that he understands:

1. How well the present security system routinely functions.

2. What the systems vulnerabilities are, and what short and long-term modifications are suggested by these vulnerabilities.

3. How well the system functions after receiving knowledge of vulnerabilities and whether the compensatory measures are working and sustainable.

Many of the studies which have addressed the question of how well security systems are likely to function against a competative adversary have been accomplished with a minimum of objective performance data. At one extreme, the absence of operational data and an integrated picture of how well present security systems work has led to abstract and highly general studies whose predictive validity is at best uncertain; at the other extreme, it has produced research efforts that are focused on specific equipment and procedures, and which have little generalizability. In some cases the result has been lack of user acceptance and indifference to new equipment and procedures. Such problems are often traceable to the system designer's inadequate appreciation of how the system will function in the hands of the user in an operational environment. The security systems performance data required for avoiding these problems have not been available because suitable apparatus and methodologies for conducting on the job performance assessment are relatively new developments. Unlike the professional football team or combat fighter squadron, operational security units have not been able to provide policy makers and system designers with objective documentation of security team performance in response to realistic events that can be replayed and subjected to repeated analysis.

The unaided human observer is limited in his capacity to do on the spot recording and analysis of actions involved in security exercises. This has produced an incomplete and fractionated view of how security systems function. Because observers have limited data recording capacity, their observations tend to be preprogrammed and restricted in scope. For example, they often focus on the guard's knowledge of procedures and his response to "what if" situations; during exercises, they may necessarily focus on end-products and final outcomes (eg., the 15 in 5 response criterion). The observational techniques used (through no fault of the observer) create the impression that the supervisor's or inspector's primary concern is with errors and failures and that those aspects of the task which were performed well were unobserved.

Because operational performance data have been unavailable, inspectors have frequently depended on secondary measures that are assumed to be relevant to good security performance (e.g., proper records, neat book work, proper dress, good attitude and appearance). When inspectors and supervisors must depend on visual observation of active exercises, debatable results are often the order of the day. More important, SSORA recordings have shown that obvious outcomes, good or bad, are usually determined by multiple events that are hidden from the on-the-spot observer. Because of this, operational personnel often complain that inspections are counter productive and characterized by "tunnel vision". This occurs because the necessarily limited observations of inspectors lead to a superficial understanding of how the interactions between security personnel, weather, terrain, site activity, training and sensor equipment impact on overall performance.

Interviews and surveys of operational security personnel and managers have produced a Pandorian listing of isolated security problems most of which are important but none of which appear to be key to improving security system performance. Unfortunately, many of the views and attitudes generated by those techniques about what is wrong or right with security systems detract from an integrated view of the systems task and how the people and equipment in the system must work together in a particular operational setting. For example, the many compensatory behaviors that are used to overcome site vulnerabilities and system limitations are not usually observed by a preprogrammed inspector. It is the limitations of the observer which lead to a preprogrammed, highly selective observational process which in turn misses many of the key functions and operations of the integrated security system.

The limitations of present techniques for conducting accurate, comprehensive job performance assessment and an integrated view of how the system functions have also led to a biasing and misdirection of research and development efforts. These efforts include surveys, modeling, laboratory studies, equipment design, task analysis and human performance assessment by inspection teams.

Attempts to apply data from laboratory and modeling studies have been a poor substitute for actual measures of system effectiveness because they have eliminated, ignored, or restricted many of the variables that are present in the real world. As a result, controlled laboratory studies produce narrow and sometimes trivial results that have little or very uncertain application to the operational system (see Mackie and Christensen, 1967; Chapanis, 1976; Simon, 1977; Miller and Mackie, 1980).

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Finally, it is important to note that, in the past, the lack of permanent records of exercise events that can be replayed for new personnel results in a corporate memory failure for compensatory measures and adaptation to site vulnerabilities. This in turn leads to a rediscovery of the vulnerability by a new set of inspectors and a reinventing of solutions to problems that were solved by predecessors. On the job performance recording by the SSORA system solves the corporate memory problem. In addition, replay provides the opportunity to determine the mix of events that produced a particular outcome, and permits an integrated task analysis which reflects total security team functioning. Analyses that have been based on traditional job analysis procedures and more limited observational techniques frequently contain information which is at odds with actual systems operation. The observer's limitations and dependence on terminal events and pass/fail criteria, have frequently obscured causal data and interactions that are critical determiners of security system performance. The SSORA system provides a technology whereby these limitations are minimized.

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THE FEASIBILITY OF A
LIGHT AND SOUND SYSTEM FOR
DELAYING INTRUDERS INTO SECURE FACILITIES

By

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1.0 INTRODUCTION

To maximize the security of sensitive areas inside buildings, the U.S. Army is developing a highly secure Facility Intrusion Detection System (FIDS) that will eventually be installed in joint service DoD facilities. The FIDS will consist of a wide variety of sensors capable of detecting intruders, together with advanced components designed to provide a second line of defense against actions performed by intruders once they have been detected. One of these advanced components is a response/deterrent device that will be activated at the central monitoring location to deter intruders from accomplishing their mission, or delay them until guard forces arrive to investigate the intrusion.

The purpose of the study described in the present paper is to explore the feasibility of using light and sound stimuli as an intruder deterrent device by generating confusion, discomfiture, and disorientation, and hence impairing the intruder's efficiency at performing tasks, or deterring him from proceeding further with his mission. The advantage of such a system is that the light and sound stimuli can be generated with readily available equipment and, by careful design, can interfere with intruder behaviors in a manner that is clean, safe, and efficient. There is no residue to dispose of afterwards and no risk of permanent physiological damage in case of false activation or accidental exposure.

2.0 SELECTION OF POTENTIAL STIMULI

As a first step in developing a possible operational deterrent system, the scientific literature on the effects of sounds and lights on people was reviewed in order to select potential stimuli.

2.1 Sound Stimuli

The various categories of sound effects on humans, the elicited responses for each category, and their probable relevance to the present program are given in Table I. This table reflects the general range of sound effects,[1-4] and is also consistent with these effects identified by the Defense Nuclear Agency[5] as being relevant for intruder delay. Some of these effects have long-term rather than immediate implications, and others are unsafe or difficult to evoke with practical equipment. A review of the information in Table I indicates that there are three effect categories that potentially can be useful in delaying an intruder, and that are at the same time relatively safe, namely:

- Psychological
- Communication Disturbance
- Musculo-Skeletal

Table I

Sound Effects Considered for the Program

Effect Category	Nature of Effect	Applicability	Stimulus
Psychological	Annoyance Confusion Fear Arousal Distraction	Proven, Safe	Multiple Tones (3000 and 3005 Hz) generating beats Police Siren -- "Yelp"
Communication Disturbance	Speech Interference	Proven, Safe	Broadband Noise
Musculo-Skeletal	Startle	Proven, Safe	Gunshot
Auditory System	Pain, Deafness	Proven, Unsafe	----
Non-Auditory Physiological	Nausea, Blood Pressure Changes, Gastro-intestinal Disorders	Not Proven, Potentially Unsafe	----

Psychological

The term "psychological" is used for effects which are functionally related to task performance, i.e., noise causes a specific response which may directly impair a human capability needed for the task — like vision, hearing, physiological homeostasis, muscle control, etc. Here "psychological" refers to responses like arousal, distraction, annoyance, confusion, and fear. Although these "psychological" effects can be elicited coincidentally by sounds which cause communication disturbance and musculo-skeletal response, they are often maximized by the presentation of multiple annoying tonal sounds varying in level and character. To produce such effects, the selected sound stimulus consisted of two pure tones at 3000 Hz and 3005 Hz, generating beats at the difference frequency of 5 Hz. The rationale for the use of these pure tones is that they cause a heightened annoyance compared to broadband noise at the same level, and that the annoyance is maximum at about 3000 Hz. The beats provide the sensation of a varying sound level and character which contributes further to uncertainty and annoyance.[6]

Communication Disturbance

There are basically three communication channels that may be interrupted:

- Between co-intruders (or intruder and outside accomplice),
- Between the intruder and the reaction forces, and
- Between the intruder and his task (subtle sounds used as cues).

Communication interference can be achieved by the use of masking noise which causes a communication "signal" (i.e., the sound which conveys the meaning one wishes to interfere with) to be rendered less intelligible or even inaudible. The level and spectrum of an effective masking noise can be determined from a knowledge of the level and spectrum of the signal. Thus a masking noise can be matched to a specific signal, or alternatively a broadband masking noise of sufficient level can mask a whole range of different signals.

The masking method described above can be applied to all three communication channels mentioned earlier. However, the addition of certain broadband masking noise, since it tends to be monotonous, can have a soothing effect contrary to the requirement to arouse, distract, and confuse (and also at variance with the needs of "startle" stimuli as described later). To overcome this limitation, the noise can be interrupted at irregular intervals.

Musculo-Skeletal

The startle response is a musculo-skeletal effect of noise that has both physical and psychological dimensions. Its physical nature includes involuntary muscle-flexures ranging from an eye blink to forward motion of the trunk.[7] The muscle-flexure in the startle response affects most tasks requiring precise motor coordination, but lasts only a few seconds. However, more complex tasks (e.g., those involving visual discrimination and concentration) can suffer performance degradation for up to one minute. The startle effect has been found previously to be involuntary and almost independent of an individual's skill in performing a task.[8]

Sound Stimuli Considered and Discarded

Infrasound was considered for the present program, but rejected because the equipment required for its generation is generally massive, especially where room volumes are high. Typical generating systems,[9] for example, involve powerful loudspeakers, jet engine exhausts, blowdown wind tunnels, large hydraulic pistons, or very large sirens. Combined with this difficulty in generation are the rather insubstantial effects noted after short-term exposures at all but very high levels of infrasound.[10]

Ultrasound was also considered for the present program and rejected on similar grounds to infrasound. Although its generation is fairly straightforward, sound at these high frequencies is highly directional, and requires special attention in transducer design and/or arrangement. The sound pressure levels at which ultrasound produces task effects are also extremely high: such effects as dizziness and loss of equilibrium are believed to require levels of 160 dB or so, well above those levels identified as the safe limit.[3]

Sound stimuli containing information (e.g., the noise of approaching security forces) were considered inappropriate to the circumstances under which the tests were to be conducted. All of the research participants would be aware that the tests were in no way really clandestine. Therefore such stimuli would have little meaning relative to task performance.

2.2 Light Stimuli

The various categories of light effects on humans, the elicited responses for each category, and their probable relevance to the present program are given in Table 2. A review of this information indicates that there are two categories that are both safe and potentially relevant, namely:

- Visual/Perceptual Disturbance,
- Postural Disturbance.

Visual/Perceptual Disturbances

A properly functioning visual system is a requisite to most tasks which an intruder may be required to perform. Therefore, if an intruder's normal visual functions are impaired or rendered useless, his task performance will likely be degraded. It is possible to impair visual functions by exposure to light stimuli of certain intensities and durations, the specific stimulus parameters being determined by the desired effect. The visual disturbances which can be safely elicited from visual stimulation are delayed dark/light adaptation and temporary flashblindness.

Dark adaptation is the process which the visual system undergoes when a person enters a dark area from a lighted area. Although the dynamic range of the visual system is large, the full range is never available as rapidly as in the auditory system. Since the adaptation time of the visual system to dark conditions is many times slower than it is to light conditions, it is possible, by flashing a light of sufficient intensity, at a sufficient rate, to render an intruder continually "blind" by never allowing his eyes to adapt fully to the dark conditions between flashes. However, the full adaptation time will be decreased in the presence of background illumination, such as that provided by an intruder's flashlight.

Table 2

Potential Effects of Light Stimuli

Effect Category	Nature of Effect	Applicability	Stimulus
Neurological	Epileptic Attacks	Proven, Unsafe	----
Visual Disturbances	Blindness	Proven, Unsafe	----
	Perceptual--Impairs Vision	Proven, Safe	Flashing Lights
Postural Disturbances	Disorientation, Sway, Decreased Motor Control	Proven in Laboratory, Safe	Moving Light/ Dark Patterns

Flashblindness is an exaggerated form of dark adaptation, wherein a spatially distinct afterimage of the source is formed on the retina, provided that the source is of sufficiently high intensity. The time for the afterimage to disappear, the recovery time, increases as the background luminance decreases. Therefore flashblindness is a potential candidate for degrading task performance in low ambient light conditions.

Postural Disturbance and Disorientation

Posture disturbance and disorientation are obvious adverse influences on intruder task performance when their symptoms are sufficiently pronounced to constitute leaning, swaying and perhaps falling, as well as a general decrease in motor control. Posture disturbance can be achieved by light stimuli that provide the visual system with a false sensation of body position. This visually induced perception of motion, called vection, can be induced in the laboratory by means of rotating patterns of light.[11] Adaptation to the ambient light conditions can be minimized by periodically flashing the source.

3.0 EXPERIMENTAL PROGRAM

3.1 Introduction

The experimental program was designed to assess the effect of selected, physically safe levels of light and sound on human task performance. Its purpose was to develop a light and sound stimulus package that significantly degrades human performance. The light and sound system is intended to be used in secure areas to stop, delay, or dissuade intruders, without causing permanent physical harm.

The experimental program was divided into two phases:

- Stage One, Pilot Testing, was designed to:
    a) assess the independent impact of the stimuli on task performance, using a small number of non-naive research participants;

    b) assess the impact of combinations/sequences of stimuli on task performance, and select the optimum configuration;

    c) pretest and refine stimulus-generating equipment, tasks, room configuration, data collection instruments, and experimental procedures.

- Stage Two, Primary Test Sequence, was designed to test the selected stimulus configuration using large numbers of naive participants performing tasks under control (with no stimuli) and experimental (with stimuli) conditions.

Before conducting the experimental program, a formal test plan was prepared and submitted to the Department of the Army, Surgeon General's Human Subjects Research Review Board (HSSRB), for review. It was approved by the Surgeon General prior to conducting the tests.

3.2 Testing Procedure

The experimental tests were conducted in a room measuring 18.5 feet by 40 feet with a height of 10 feet. For all trials, the room was darkened and the participants were equipped with a 2D-cell flashlight.

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Two research participant populations were used during the present program. Naive participants, males, 18 to 25 years of age, were utilized throughout all stages of work, performing just one task under one experimental condition. Non-naive participants, Wyle personnel, including project research staff, were utilized repeatedly only during Stage One, Pilot Testing under a variety of experimental and control conditions for stimulus screening purposes.

The research participants were questioned concerning health, vision, and hearing problems. Participants who did not meet the safety criteria established for the proejct were excluded from participation. Qualified participants filled out informed consent forms and were then assigned to one of two groups: one group initially performing a task under control (no stimuli) conditions, followed by a test run with a different task under experimental stimuli conditions; and an experimentai-only group, performing one experimental condition run with no exposure to control conditions.

Throughout the testing program, safety was assured by excluding research participants with medical problems identified from medical histories, by performing pre- and post-test audiometric tests, and by providing safe conditions and safety devices in the test room. To ensure that safe conditions existed within the test room, none of the light and sound stimuli included frequencies or intensities with the potential to cause permanent physical effects or EEG photic driving (seizures). The A-weighted sound levels were set at 110 dB for continuous sound stimuli, while impulsive sound levels (bangs) did not exceed 120 dB. Furthermore, impulsive sound was not mixed with continuous sound, but was preceded by a brief period of silence that was continued through the presentation of each bang.

Finally, physical devices were located in the test room to provide for participant safety. These devices included a vision port to ensure that participants were under constant observation and could have been removed had a difficulty developed. The control panel contained a single switch to turn off all sound to the test room. Each participant was provided with a radio transmitter attached to his belt that could be actuated by pressing a button if he were in any form of distress. Finally, a local physician was informed about the test program and made available to respond if any health problems arose.

As a result of these safety precautions, no health problems arose in the testing program. No research participants were injured, and none experienced visual or auditory after-effects that extended more than a few hours after exposure.

3.3 Performance Tasks

Five performance tasks were created to replicate portions of likely intruder behavior. They can be broadly grouped into two categories:

a) tasks emphasizing cognitive functioning, and
b) tasks emphasizing physical performance.

The tasks emphasizing cognitive functioning were Document Sort and Control Panel tasks. The tasks emphasizing physical performance were the Crawford Small Parts Dexterity Test, Voice Communication, and Gross Motor Coordination.

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- Crawford Small Parts Dexterity Test – selected to address those portions of an intruder's behavior requiring fine motor control and close eye-hand coordination. The task consists of two parts: screwing screws into threaded holes using a screwdriver, and the placement of pins in holes and metallic collars over the pins using a tweezer.

- Voice Communication – simulating the situation where two or more intruders enter a secure facility, and need to coordinate their actions by voice communication.

- Document Sort – simulating the behavior of an intruder looking for specific documents in a fiie cabinet, addressing reading skills and cognitive functioning in the form of the development of search patterns and decision making.

- Control Panel Task – designed to simulate those portions of intruder behavior where the intruder must remember a set of instructions or a numerical sequence (e.g., a safe combination) and is required to use that information in the secure facility. This task focused on memory and arithmetic cognitive functioning.

- Gross Motor Coordination – designed to simulate the intruder situation where two or more intruders enter a secure facility and remove a quantity of objects.

4.0 TEST RESULTS AND CONCLUSIONS

4.1 Definition of Final Stimuli Characteristics

Throughout the pilot test phase, three issues were of primary importance in developing the final stimulus configurations: the effectiveness of each stimulus in degrading task performance, the compatibility of each stimulus with the others, and safety. The research effort was oriented toward developing a stimulus package that not only was effective, but also functioned as an integrated unit with individual stimulus components well matched to each other.

As a result of the pilot test phase, four sound stimuli were selected, together with two types of light stimuli, to produce the final stimulus configuration. The four selected sound stimuli were:

- Broadband white noise, filtered to eliminate frequencies below 100 Hz and above 2900 Hz, at a sound pressure level of 105 dBA;

- A commercial electronic police siren, set on the "Yelp" mode, at a sound pressure level of 105 dBA;

- Two pure tones, one tone fixed at 3000 Hz, the second tone fixed at 3005 Hz, at a sound pressure level of 105 dBA;

- Impulsive noise, "bangs", at a peak sound pressure level of 120 dB.

The two light stimuli were:

- A repeating strobe unit, 50 joules per flash, operating at one flash per second, directed at the task work surface;

- Six standard photoflash units placed on the test room walls, operating at a variable rate in the range of one flash every one to two seconds.

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Two variations of rotating patterns of flickering light intended to produce posture disturbance were tested and discarded. Previous experiments have successfully utilized rotating patterns of flickering lights, under laboratory conditions, to produce a vection effect. Two types of mechanical devices producing rotating, oscillating, and flickering lights, with several different light patterns, were assembled and tested in the pilot test phase. In neither instance was a significant vection effect evident. It was concluded that the presence of non-moving objects in the room provided a fixed frame of reference, thus eliminating the vection effect.

4.2   Test Results

Method of Analysis

For each of the five tasks, two effects of the stimuli were analyzed separately: the time that participants required to complete the task, and the number of errors that they made. For each task, differences in time and error counts between experimental and control groups were determined by using t-Tests.

Two variations of experimental conditions were utilized – participants either first performed a control condition task before performing a different experimental condition task, or they just performed an experimental task without any control task experience. Thus three t-Test comparisons were made: control condition/subsequent experimental condition, control condition/experimental-only condition, and control condition/both subsequent experimental and experimental-only conditions combined. Separate analyses were indicated because the participant's experience in the test room under control conditions might have reduced his apprehension under subsequent experimental conditions. Very little difference was found, in terms of statistical significance, direction, or magnitude of effects between the three differing forms of analysis. Therefore, for brevity, the table that follows reflects only those comparisons utilizing the full data set (control/both subsequent experimental and experimental-only conditions).

Where statistical analysis demonstrates that the experimental stimuli have degraded the participants' time performances, the delay factor of the stimuli is presented. The delay factor is defined as the ratio of the time to perform the task under experimental conditions to the performance time under control conditions. The delay factor is thus the fractional change in performance time produced by the stimuli.

The distribution of research participants by task and test group is displayed in Table 3. The total participant sample available for comparison was 195. However, because of problems with some participants' understanding of the directions for the task to which they were assigned, as well as coding and transcription errors, only 177 cases were used for the analyses.

The test results are summarized in Table 4, showing performance degradation in terms of the delay factor, in terms of errors, and the statistical significance of both these quantities.

Performance Degradation — Time

Participants performing three of the intruder-like tasks, under experimental conditions, clearly demonstrated that the stimuli have a significant delay factor. The performance times are summarized in Table 4. It took substantially longer for participants to complete the Crawford Small Parts Dexterity Test, Voice Communication,

Table 3

Distribution of Subjects by Task And Test Group

TEST GROUP	TASK					
	Crawford Small Parts Dexterity Test	Voice Communication	Document Sort	Control Panel	Gross Motor Coordination	Total
Control Condition	17	1	10	20	26	74
Experimental Condition	13	1	14	14	27	69
Experiment Only Condition	6	9	9	3	7	34
Total	36	11	33	37	60	177

Table 4

Summary of Test Results

TASK	TIME		ERRORS	
	Statistical Significance*	Delay Factor	Statistical Significance	Performance Degradation
Crawford Small Parts Dexterity Test	YES	1.42	MARGINAL	375%
Voice Communication	N/A	$\geq$2.00	N/A	570%
Document Sort	YES	1.26	NO	NO
Control Panel	YES	<1.00	NO	MARGINAL
Gross Motor Coordination	YES	<1.00	NO	NO

* Using 95 percent confidence level as the criterion for significance.

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and the Document Sort tasks in the presence of the light and sound stimuli than under the control conditions. The magnitude of this effect ranged from an inability to complete the task (Voice Communication) in the time allotted, to a delay factor in the range of 1.26 to 1.42 (Crawford Small Parts and Document Sort).

The research participants did not demonstrate a performance time degradation when performing two tasks, Control Panel and the Gross Motor Coordination, but completed these two tasks in less time under experimental conditions than under control conditions. These tasks have one common element that may provide an explanation: they both involve substantial amounts of walking within the test room. It was observed that the participants, under control conditions, walked rapidly from location to location in the test room. However, under experimental conditions, they were observed to run from location to location. Clearly, the light and sound stimuli used, at the intensities and frequencies permitted (consistent with participant health and safety), did not interfere with the participants' walking ability. At the same time, the uncomfortable nature of the stimuli motivated them to move quickly, so as to leave the test room as soon as possible. It is possible that exposure to higher levels would encourage even more rapid movements resulting in an increase in errors.

Performance Degradation — Errors

The stimuli showed a significant performance degrading effect in terms of error rates for two of the five tasks: Crawford Small Parts Dexterity Test and Voice Communication. The percentage change for the Crawford Small Parts Dexterity Test is 375 percent, indicating that participants, under experimental conditions, had increased difficulty controlling fine motor functions and eye-hand coordination. The increase in error rate from 1 to 50 percent for Voice Communication is consistent with the observation that the stimuli almost totally disrupted the ability to communicate verbally. Three tasks, Document Sort, Control Panel, and Gross Motor Coordination, demonstrated no performance degradation in terms of error scores.

The Document Sort and Control Panel tasks emphasized cognitive functioning. The data indicate that the stimuli, at the intensities and frequencies permitted, did not disrupt the types of cognitive performance required for these tasks. One caveat is important here, however. Participants performing the Document Sort required a longer time period to complete the task. While they did not demonstrate a concomitant increase in errors, it may be that the participants traded time for accuracy. That is, the participants took a longer time in order to ensure that they performed accurately. Finally, the Gross Motor Coordination task demonstrated no increase in error rate.

4.3 Conclusions

The data indicate that the stimuli have a significant delay factor for certain types of intruder tasks. They have a substantial impact on eye-hand coordination, fine motor control, and the ability to rapidly read, search, and make decisions associated with finding target documents in a filing system. In addition, they almost totally disrupt voice communication. However, the particular stimuli chosen do not affect the ability to walk.

Given that the light and sound stimuli were conservatively safe for human exposure, and that the test conditions could not duplicate the apprehension associated with a real intruder situation, the results appear to be quite encouraging. It is not possible to extrapolate these data to predict the delay factor at higher exposure levels. However, it is reasonable to assume that the effectiveness of the stimuli at degrading task performance should increase — perhaps substantially — with increasing levels.

Further research is presently being conducted to investigate the effects of somewhat more intense stimuli for potential inclusion in a hardware system. The significant behavioral effects already achieved on oral communication, eye-hand coordination, and searching efficiency, all essential elements in the highly uncertain environment of the intruder, offer promise of developing a security system that serves as a clean, safe, and efficient retardant.

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THE MAN/MACHINE INTERFACE AS IMPACTED

BY THE ECOLOGY OF THE SECURITY PERSON

Clifford E. Simonsen, Ph.D.

and

Alexander G. Schauss, (Ph.D. Candidate)

Electronic sensors alert to the pressure on the fence and send a silent message to the lights on the control panel of the observation tower. "Damn!", grouses the security person to himself, "Another rabbit out there again!" He picks up his field jacket and reaches for the door. As it is opened he is hit with a frigid blast of winter air, chilling the warm tower and causing him to pause. "To Hell with it!", he mutters, and decides to reset the warning light and stay inside. After all, rabbits had already set off those silly sensors four times this week! Settling back in the warm chair, the security person looked forward in his mind to another drinking bout with his buddies at the beerstube at the end of this miserable shift. Maybe that guy from Headquarters Company will even score some grass again? Warming his hands on the hot coffee cup, he puffed contentedly on a dark cheroot and daydreamed, failing to notice the blinking light on the infrared scanner panel...until the door exploded inward and the wild-eyed terrorist in the flat black clothing burst through and pulled the trigger on the silencer-equipped UZI.

Several miles away at another site, the environmental control technicians were busy "scrubbing" the air in the computer control room. They were making sure that the hundreds of circuits, switches, lights and wires, tubes and conduits were all in perfect working order. Expensive lubricants and costly sprays are being lavished on the sensitive and expensive mechanisms of the various security devices. With their service procedures finished, the technicians headed out of the door, stepping aside for a bedraggled-looking security person on the way into duty. When he got to his control panel he lethargically ran through his checklist, swatting at the dials and switches mechanically. He winced as his stomach growled while trying to digest the greasy hamburger and fries he had gulped down at the snack bar on the way in. With several candy bars and a package of cheeseballs in his pockets, however, he was sure he could control the "hungries" later. Pouring a cup of hot coffee, he added his usual two heaping spoonfulls of sugar. Stirring it absentmindedly, he did not notice that some of the sticky fluit splashed over the edge of the cup and onto the switches and relays next to his duty station. As he settled in under the flickering neon tubes in the tower he stared vacantly into the night, with no way of knowing that all the sensors in Sector 3 were unable to send their urgent signals through the sticky switchboard.

A science fiction scenario? Hardly! In today's high powered environment, this kind of situation is far from any kind of fiction and too close to fact. The technological tools of the security profession of the 1980's have evolved to a level of almost mechanical perfection.

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Computers and similar high-tech devices are kept in clinically sterile
environments and great care is given to selection of the ingredients in
and ecologies of these 21st Century machines that protect our nuclear
and other assets. It is ironic to note that the PERSON who operates
and monitors these almost magical mechanical and electronic marvels has
changed very little since the time when man's treasures were guarded
with a club! As a matter of fact, the modern era presents a large
number of ecological distractions for the security person. Long shifts,
bad air, junk food, coffee, cigarettes, and artificial lighting denegrate
the security person's ability to remain alert and be able to perform.
This can be presented as a "window of indifference", as shown in Figure
1. The area from point A to point B is that zone in which the person
monitoring various sensors and senses will not be alerted too soon nor
ignore those signals when they arise. This paper addresses some of the
causes of these kinds of ecological problems which impact the interior
and exterior ecology of the MAN part of the "Man/Machine Interface".

In the past, considerable attention has been devoted to the psycho-
social factors that impact and determine human behavior. It is only
recently that at least some consideration has been given to those
environmental and biochemical factors that seem to effect human behavior,
both individually and in social groups. Recently the behavioral and
medical sciences have begun to collaborate on hybrid studies that have
shown some amazing results. Many of these findings show great promise
for practical application in the concerns of security professionals,
whether at a nuclear security site...or in our nation's prisons and

THE SECURITY PERSON'S "WINDOW OF INDIFFERENCE"
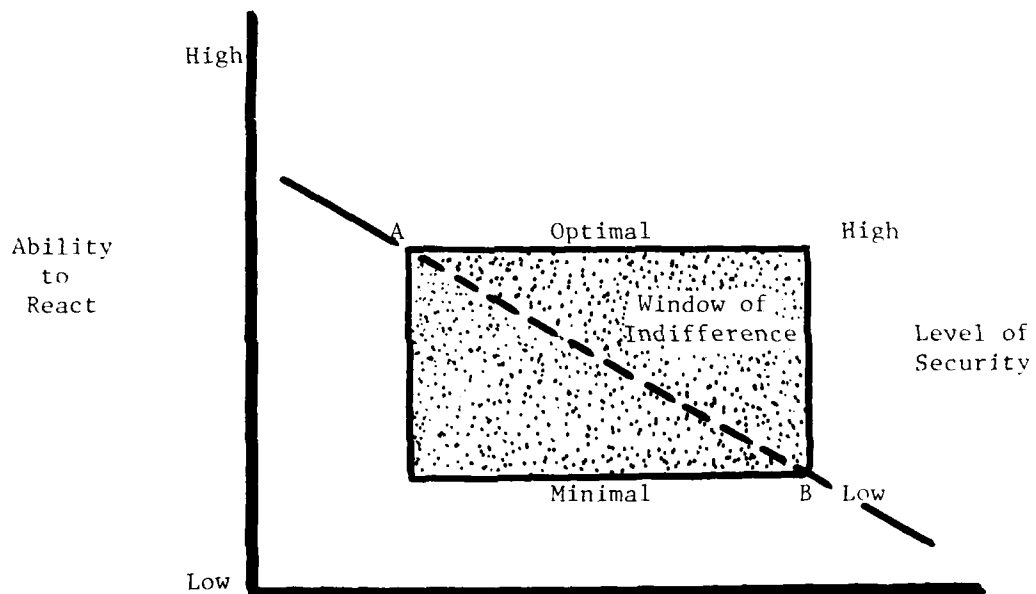
Environmental Ecology of Security Person
(Fatigue, poor air, drugs, food, light, etc.)

FIGURE 1

jails, where much of the most significant reserach has been conducted.

Carefully designed studies, using sophisticated double-blind and random selection procedures clearly indicate that one of the most over-looked areas in regard to the effectiveness of the security person relates to biochemical/genetic factors. These multidisciplinary studies also highlight the importance of nutritional patterns and environmental sensitivity of the security person. Just these three areas have shown strong indications of the value and application of relatively simple techniques by trained personnel to help enhance security in the "real world" settings, from department stores to nuclear security sites.

Specific nutritional and dietary habits have been of especial interest to biosocial scientists who investigate, evaluate and integrate multidisciplinary studies. For example, excess consumption of refined carbohydrates have been shown to clinically reduce levels of particular nutrients. This can reduce effectiveness and have a significant impact on security concerns. Research conducted since 1948 indicate that some major nutrients, even at sub-clinical levels of deficiency, can reduce inhibitions and reduce the fear of social consequences. These results have been demonstrated in both animal and human studies again and again, under controlled conditions. Nutrition has been shown to be a major factor in such critical areas as: concentration, awareness, recognition, cognitive factors, alertness, fatigue, impulse control, sensitivity to criticism, sleep patterns, mood swings and emotional restraint. Bio-sociologists have developed and are developing sophisticated screening techniques to aid the security administrator in determining whether the

security person has become vulnerable to behavior fluctuations induced by lifestyle factors and environmental factors...fluctuations that might jeopardize the whole security program.

Biosociology is the science that studies the environmental, genetic and biochemical factors that affect individual behavior and social groups. A biosociologist sees behavior from many dimensions: psychological, sociological, genetic, and environmental. Part of that environmental concern may explore the relationship between petrochemicals or metal neurotoxins and the effect on brain chemistry and behavior. Genetic concerns may involve evaluating data suggesting a relationship between DNA and behavioral patterns. Nutritional patterns, such as excessive protein intake and their effects on gastrointestinal health, related to toxic amine waste products, as they relate to aggression, or gross apathy may fall within our interests. And it is in this latter area, that of nutrition, that we will examine by concentrating on new research concerning nutrition and behavior pertinent to the field of security.

Recent interest in the effects of nutrition on behavior by anthropologists, sociologists, psychologists, and criminologists, is increasing our knowledge of the relevance of diet to all kinds of disordered behavior. For example, Bolton (1973), an anthropologist, found the Qolla Indian society in Peru to be the "meanest and most unlikeable people on earth." Their diet was found to be very low in protein and excessively high in carbohydrates (i.e. sucrose, white flour, etc.) Clinical studies revealed that for the villagers to keep their blood

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sugar near normal, they frequently fought, injured themselves, chewed the cola leaf, or drank alcohol. In one village alone, Bolton found that 50 percent of nearly 1,000 persons had been directly or indirectly implicated with a homicide! His research is interesting in light of recent research correlating hormonal participation in behavioral disorders and its relationship to neurogenic mechanisms related to dietary intake.

For example, Hudspeth's research at the School of Medicine, University of Nevada-Reno, reveals that excess intake of simple sugars can produce hyperinsulism resulting in significant increases in brain serotonin levels. The neurohormone serotonin and its secondary metabolite (S-HIAA) has been implicated by animal and human studies as a producer of aggressive behavior. Given that several simultaneous biochemical events can transpire in the human body, you can create a Co-eval Complex Psychobiochemical Dissonance.

Many officials in the field of corrections have observed an excessive use of refined sugar (sucrose) by offenders. In one study of chronic offenders and their matched controls (non-offenders), offenders consumed an average of over 46 teaspoons of sucrose in their diet per day.

At the Lantana Correctional Institution for Males (Florida), Dr. Dianna Fishbein conducted a study of 104 inmates. This population was divided into two groups: those that had nutritionally induced chronic endocrinopathy (commonly called hypoglycemia or 'low blood sugar') and those that did not. Each of these two groups were divided into two

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sub-groups and placed on either the typical institutional diet, rich in refined carbohydrates (i.e., sweetened cereals, Jello, white flour products, sodas, Kool-Aid, etc.), or a diet low in refined carbohydrates (i.e., virtually free of refined sugar or white flour products). Evaluation of the data showed a significant improvement in the behavior of only those inmates who had hypoglycemia and had been placed on the low refined carbohydrate diet. Their behavior had so significantly improved by the end of the study that both involved staff and inmates requested that the experimental diet be continued.

Six separate clinical studies of low blood sugar among inmates indicates that the rate of hypoglycemia is between 80 to 86 percent. Therefore, the above study would suggest that a majority of incarcerated offenders might benefit from a low refined carbohydrate diet. Might this not also apply to our security forces as well?

Further support for a lowered sucrose intake comes from a recent double-blind study. At the Tidewater Detention Home in Chesapeake, Virginia, a study was conducted by Schoenthaler in which significant reductions were made in sucrose consumption without the staff or detainee's knowledge. Evaluation of this double-blind study revealed that disciplinary infractions had significantly decreased during the seven month study period as compared to the pre-experimental study period. More importantly, the most significant behavioral improvements were measured and observed in the more severely behaviorally disordered detainees. A recent two year follow-up study by Schoenthaler reveals a 48% drop in rearrest rates among the experimental population, (p=.00001).

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At a more down-to-earth level, the problems involved with abnormal blood glucose level can also be translated in relations between spouses. (A problem that can surely impact the effectiveness of a security person). At the Santa Barbara, California, branch of the American Institute of Family Relations, Mary Jane Hungerford, Ph.D., has found that in nearly 75% of the cases she sees involving serious marital discord, particularly wife-beating, the abuser clinically reveals an abnormal blood glucose level upon glucose-tolerance testing. In many, a sudden drop in blood sugar triggers violent impulses or even suicidal depressions. Such symptoms as depression, anxiety, and uncontrollable tempers, she has found, show the most marked improvements after dietary restrictions or adjustments have been made. She reports that within several weeks after commencement of a nutrition education program, 80% of the couples report a significant improvement in their relationship.

For over 40 years, medical authorities have reported that patients sensitive to certain foods and environmental substances or inhalents were observed to go through remarkable transformations in personality and behavior, upon exposure to an offending food or environmental substance. In some cases the behavioral changes are recurring, while in others occur only once. For example, in one recent case of attempted murder, a 47 year old corporate president shot 25 people after ingestion of only one ounce of a particular red wine. Double-blind studies at two prestigious universities revealed that his cerebral allergic response to a particular amine within the wine provoked paranoid schizophrenia.

At the Behavior Research Institute, Peacham, Vermont, William J.
Lederer, M.D., Ph.D., examined 312 couples experiencing serious marital
crises. In 57% of these cases, at least one spouse was discovered to
have a treatable biochemical imbalance that could later be demonstrated
to provoke the negative behavior. This was particularly true if the
problem involved a sensitivity to a food(s). After eliminating the
offending food(s) from the individual's diet, the person would normally
report a heightened sense of well-being and improvements in their
relationship with their spouse. However, when the offending food was
reintroduced into the diet, a worsening of behavior and coping skills
would appear, usually within hours and, in some cases, minutes.

Some of the most common problems Dr. Lederer discovered in the
couples were: cerebral allergic reactions to offending foods, parti-
cularly milk, wheat, refined sugar, coffee, chocolate, house dust, corn,
eggs, yeast, alcohol, citrus fruits, peanuts, and tomatoes; nutrition-
ally induced chronic endocrinopathy; improper levels of vitamins and
minerals; elevated of neurotoxins; and either plain malnutrition or
overcompensation malnutrition.

A study published in The American Journal of Clinical Nutrition,
conducted by Lonsdale and Shamberger discovered that a population of
intractable neurotic adolescents were low in Vitamin B-1 (thiamine).
It had been demonstrated for decades that any excessive diet rich in
refined carbohydrates (commonly called 'junk foods' in North America),
could cause a deficiency over time of Vitamin B-1. Since Vitamin B-1
is an essential nutrient for the proper functioning of the brain and

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central nervous system, its lowered levels can have particular conse-
quences for the brain and behavior. This is a matter of considerable
applicability to the young service member we find in our security sites
around the world. A remarkable finding was that all those found to have
low Vitamin B-1 levels, displayed the following behavioral characteris-
tics: hyperaggressiveness, hostility, irritability, a sensitivity to
criticism, an inability to deal with rage, and poor impulse control.
These subjects were given supplements of Vitamin B-1, far above the
Recommended Daily Allowance (RDA), to saturate the tissue with the miss-
ing nutrient. Through this program of nutritional supplementation or
megavitamin therapy, all subjects were reported to have significantly
improved within several weeks.

In 1948, the National Academy of Science reported that lowered
Vitamin B-1 levels in humans could reduce our fear of social consequences.
Evidence from animal studies in Japan in the same year reported anti-
social, even matricidal behavior, in those animals placed on a Vitamin B-1
restricted diet.

Again, we re-examine the example of behavior between spouses. Work-
ing with Dr. Don D. Jackson, Dr. William J. Lederer studied a group of
278 young and middle-aged couples with troubled relationships. The
majority of these couples were characterized as suffering from a "fatigue-
irritability-irrational-behavior syndrome" (certainly a syndrome the
security manager would avoid like the plague!) This syndrome they found
to be common in couples experiencing constant discord, while none existed
among a control group of couples with satisfying relationships. The

symptoms associated with this syndrome are: fatigue, depression, un-predictable temper tantrums, moodiness, forgetfulness, insomnia, head-aches, anxiety, irritability, crying spells, indigestion, compulsive eating, pain in muscles and back, difficulty in concentrating, and sensitivity to noise and light. The latter two symptoms are interesting as they are reported by Michael Lesser, M.D. as related to deficiency levels of Vitamin B_2 and B_6. Additional recent double-blind studies are now confirming these initial reports.

Clinical ecology is the study of an organism's interaction with its environment, and the relationship of this interaction to both physio-logical and psychological symptomatology. Recent double-blind clinical ecological studies have measured immune system functioning, brain chemical changes, and other biochemical parameters, before, during, and after hypersensitive reactions. These studies have provided some of the first strong biochemical and nutritional interrelationships to behavioral patterns.

No discussion of nutrition and behavior can disregard the problems associated with alcohol and drug misuse. To date no cause and effect relationship has been found between alcohol or drug misuse and diet. However, nutritional therapies in conjunction with psycho-therapeutic modalities do seem more promising than psychotherapy alone.

The effects of excessive alcohol or drug misuse can contribute to dietary patterns leading to nutritional imbalances. Some of the ways that drugs and nutrients interact are:

decrease the synthesis of some vitamins and minerals;

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change appetite and taste perceptions;

cause malabsorption syndromes;

increase nutrient requirements;

block normal metabolism; and,

promote excretion of nutrients.

Drinking alcohol with sweet mixes on an empty stomach can, in some offenders, produce a state of confusion, irrational behavior, and eventual loss of consciousness or temporary amnesia. Chronic excess intake of alcohol can lead to deficiencies of zinc, protein, Vitamin B-2, folic acid, magnesium, iron, pantothentic acid, and copper, in addition to, cirrhois of the liver, pancreatitis, gastritis, and anorexia.

Some common drugs in combination with alcohol can have particularly serious nutritional consequences. As we have discussed earlier, Vitamin B-1, has been linked to particular behavioral characteristics of interest to our concerns. In one case, a 25 year old male offender with a particularly violent history, including four separate counts of aggravated assault and attempted murder, indicated he had a history of gastritis. He was self-medicating this problem with chronic use of a popular antacid. Unknown to him was the knowledge that all antacids have a tendency to destroy Vitamin B-1 (in addition to stress, stimulants, and nicotine) when used in chronic excess. It can also lead to poor absorption of iron and decreased absorption of other essential central nervous system nutrients, such as magnesium and phophorous. Besides the fact that he had a severe case of reactive hypoglycemia, he had other nutrient

related imbalances. Through a program of nutritional education and medically supervised nutritional supplementation, he finally responded most favorably to a therapy program. An excellent reference work on this subject is Roe's Drug-Induced Nutritional Deficiencies. Two excellent works on alcohol and diet are Roe's Alcohol and the Diet and Poulos, Stoddard and Carron's Alcoholism, Stress and Hypoglycemia.

A recent study by the Veteran's Administration in Texas by Guenther (1981) found that the combination of nutritional supplements, nutritional education, and psychotherapy, produced an 81 percent rate of sobriety after six months, as compared to only 34 percent for the control group receiving psychotherapy alone. This work has been further supported in double-blind studies by Poulos (1981).

Since we know that well over 50 percent of the persons in the age group of our security personnel drink to intoxication with varying frequency, the relationship between this factor and on-the-job behavior seems quite relevant to our security concerns!

In 1982, over 3,000 food additives were approved and being used in American food. In the United States alone, over 800 million pounds of these food additives are produced each year. This would suggest that the average American is consuming around 4 pounds of these chemical additives per year in his/her diet. The mose processed the foods are one eats, the more food additives one will consume. Biosocial research- ers agree that there is no more important area for research than in behavioral toxicology...to see what these chemicals may be doing to our central nervous system and brain.

In 1973, Feingold, an allergist, brought particular attention to the possible problems of some common food additives, such as the artificial food dyes, preservatives, and flavors, to world attention. Quickly challenged by the medical establishment and food processors, a series of double-blind studies were carried out by universities. Early studies reported insignificant results, creating persistent controversy and confusion about the possible dangers of food additives as related to behavior and learning. Not until 1979, did a team of researchers discover that prior studies had not appropriately estimated the actual dosage of artificial food dyes consumed by targeted populations (i.e. 6 to 12 year olds). Their double-blind studies revealed that upon challenging hyperkinetic children with the more realistic dosages, 17 out of 20 children tested, in each series of tests, had significant reactions to the food dyes. This along with Weiss' (1980) double-blind study, which appeared in the same issue of Science, lent credibility to Feingold's initial observations. More importantly, certain additives exist in the North American food supply that have been linked by foreign universities to hyperaggression and hyperkinesis.

At the University of Mainz, School of Medicine, Department of Psychiatry, Roy-Feiler and Starzinski carried out careful double-blind studies for the West German Ministry of Health, at the urging of a research pharmacist, that a popular food additive, phosphates, may be directly linked to aggressive behavior. Phosphates are used in almost all American processed food, particularly sodas as phosphoric acid. Do our security persons drink colas? Recently the German Criminological

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Society published a book on this subject in German. A translation into English is promised in 1983. The West German researchers discovered that in children and young adults with particular patterns of violence and an inability to control rage, phosphates alone could indeed produce highly undesirable behavioral patterns. Examples of such behavioral changes are reported in Diet, Crime and Delinquency.

One of the leading sources for phosphates in the Western Hemisphere are sodas. It is estimated that 12 mg. of phosphates are found in a typical fluid ounce of sodas. Americans are on a soda binge, with the average citizen consuming over 412 cans of soda per year, twice the fluid consumption of milk and dairy products combined. Adolescents are reported to consume 836 cans per year, while behaviorally disordered children consume nearly twice that amount in many cases. The combination of a high phosphorous to calcium diet with added phosphates, has been demonstrated to reduce trace mineral levels in tissue, as well as upset the phosphorous to magnesium ratio. This ratio has been shown in animal studies to be an important variable in ascertaining the etiology of hyperaggressive behavior. Recent single subject studies on selected severely behaviorally disordered students in the United States and Canada, confirm the importance of reducing the phosphorous load, through elimination of sodas and other phosphorous rich food, while restoring the intracellular phosphorous to magnesium ratio back to normal ($2\frac{1}{2}$:1). When this is accomplished, the results have been referred to by school psychologists and school principals as "remarkable." Normally changes can be seen in hours, not days.

Examining a common problem for female service persons and spouses, medical specialists estimate 9-12 million American women of child bearing ages (12-42) have luteal phase premenstrual tension syndrome. This syndrome is characterized by four forms: PMT-A nervous tension, anxiety neurosis, irritability, and mood swings; PMT-C increased appetite, craving for chocolates and sweets, headaches, dizziness, and heart pounding; PMT=H weight gain, swelling of extremities, low abdominal bloating and tenderness, breast congestion and tenderness; PMT-D depression, forgetfulness, crying easily, confusion, and insommia. Many factors, including diet have been implicated in this syndrome. The most significant positive responses for women have been through nutritional therapies. In a recent case at the American Institute for Biosocial Research, a 21 year old female working on a naval ship building project found herself resigned to severe bouts of depression once a month. This had begun at age 18. The combination of a "junk food" diet and lack of exposure to sunlight was found to be the predisposing factor. Prompt treatment over a three week period of several hundred milligrams of Vitamin B-6 and a reduction to processed/refined foods resulted in complete remission in her condition in one month. After over 100 hours of psychiatric care and hospitalizations which had resulted in no change, she returned to a normal, functional life.

Certain technological innovations can benefit the security administrator as well. In one area, substance abuse, there are radioimmunoassay techniques that make it possible to determine unequivocably whether security personnel have consumed any opiate-based substances or cocaine...

using only one strand of hair! Such technology is quite inexpensive, but not in wide use as yet by security agencies. This combination of technology, common sense and biosociology <u>can</u> provide valuable tools in the effort to provide more effective security at our nuclear sites. It is clear that the need to provide answers to the questions about these techniques lie in rigorous research conducted in the environment of nuclear security. While we spend billions of dollars on weapons systems, it seems prudent to also take a closer look at the most important environment of all...the ecology of the security person and the ecologies of those that build, maintain, transport and operate these systems as well.

True scientific inquiry is open to the examination of all possible causes for a specific event. The effectiveness of security programs, as well as many other activities have been shown to have been greatly impacted by the behavior of people. What causes certain kinds of behaviors that denigrate our security posture has been in question by many disciplines. If we choose to exclude many theories because they do not fit a preconceived "mold" we limit our range of inquiry at a time when even more unusual studies than were discussed herein have begun to provide statisically significant relationships to behavior. Varieties of light, colors, ions in the air, sound patterns and radiations are being explored as well. The prudent security administrator will take the time to examine the results and see for themselves the value of taking better care of the oldest part of the security hardware, man himself.

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"You have no right to make me think about this!" The De-legitimation of Current
Nuclear Policies Among Key American Elites

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Until fairly recently, most segments of the American public, particularly our various elites, supported American nuclear policy, namely the maintenance of large and expanding nuclear stockpiles, the official foreswearing of the use of these weapons in a strategic first-strike, and the policy of threatening retaliation for Soviet nuclear attacks in war, by nuclear attacks on enemy cities and military centers. There is increasing evidence that this support is rapidly eroding; especially among key American elites. This is shown through increasingly vocal dissatisfaction with the continued growth and modernization of the nuclear stockpile; and second, in the dawning awareness of a discrepancy between our official policy of "no first-strike" and contingency plans to employ first-strike tactical nuclear weapons in the event of a Warsaw Pact attack upon Western Europe. Concerns have surfaced here due both to distaste at the growing size of our nuclear arsenal and the perception that we have not been altogether honest in our official stance of a no first-strike with nuclear weapons. Increasing numbers of Americans are coming to see our nuclear policy as inconsistent, senseless, and, most significantly, immoral, and therefore support a nuclear freeze.

I teach at Culver Military Academy, Culver Girls Academy -- two private college prepatory, coordinate, boarding schools with 800 students located in the cornfields of Northern Indiana, some 120 miles from Chicago. My school exemplifies the complicated, sometimes contradictory, changing and rapidly eroding support for the present American nuclear policy. Culver is obviously an elite school, at least a school for children of elites. A working definition of "elite," as I intend to use it, is as follows: that minority which through a combination of economic, social, economic and social relationships exerts, relative to its small size, a measureably disproportionate impact upon society. This group includes professionals, proprietors of large fortunes, politicians at the state and national level, high ranking military officers and cultural-religious leaders.

In Culver's case, most of our students come from the Middle West, although some come from the South and Latin America. Although Culver has students from all parts of the United States and many foreign countries, it is essentially a Middle Western school. We embody many of the attitudes of the Middle West, and these are, in turn, passed on to our students.

One might be tempted to dismiss the growing concern about nuclear matters as a fad, or at the very least a concern of the "quiche, white wine and Volvo set," or perhaps of the effete East, or wacky West Coast. This would be a grave mistake, for there is more involved here than faddish liberalism, particularly when one addresses the views of young people on this issue. I see a growing concern among the young at Culver and throughout the country about nuclear weapons, when the question is raised to a high salience level. [1]

An article in the Harvard Magazine triggered my interest in this issue. It was entitled, "But What About the Russians? A Psychiatrist Looks at American Nuclear Arms Paranoia." [2] The author discussed, among other things, the results of questionnaires and interviews given to adolescents living in the Boston area "seeking to assess their experiences of living in the nuclear age." [3] The study "noted a shift in these three years (1978, 1980, 1981) in the direction of increased preoccupation with the threat to their lives that the arms race

represents for these young people." [4] One response was of an inchoate fear, "the terror that lurks beneath the surface." [5] One seventeen year old was asked when he first became aware of nuclear issues. His reply: "Very young, seven or eight. It was a dream . . . I did not know what the dream was at the time. I felt intense fear and complete and utter destruction. This dream came back throughout my childhood, and it was not until five or six years ago that I figured out that this dream was a nuclear holocaust. Thinking of it scares me more than anything I have yet known. [6]

Although the response of Boston teenagers to questions about nuclear weaponry were varied, there were some common themes in their replies: 'lack of control; a feeling of helplessness; a sense of things running haywire; a loss of confidence in the political process; alienation from adults who would subject them to a threat of total annihalation; and a general turning inward . . . " [7]

It would be very tempting to dismiss this a a biased work, representative perhaps of the effete East, but not of the greater American public. I almost wish that such were the case. I decided to probe my own students for their responses to the issue. Last Spring I raised the issue in my class, reading key parts of the article and inviting a discussion of the issues raised there. The response of one student said it all: "You have no right to make me think about this!" One student made this comment: "Just the idea of nuclear weaponry affects my thinking of the future and my view of the world. I don't think about the question." [8] That answer reveals a great deal about the nature of this topic. While students at Culver do not stay awake at night worrying about nuclear war, evidence clearly shows that they react in powerful ways to this problem, when it is brought to their attention.

Early in the school year I administered a number of questions about nuclear weapons and nuclear warfare to my classes. (The questionnaire is found in the Appendix.) One of the key questions affecting current public policy is number 6: "What do you think of the idea of a freeze on the manufacture and placement of nuclear weapons?" This is especially a key question since Wisconsin voters endorsed the idea of a nuclear freeze by a three to one margin. The results were as follows: 24 endorsed the idea of a nuclear freeze; 12 were against it. [9] When asked whether the United States should embark on this alone, or only with Soviet acquiescence, the classes responded as follows: only 6 thought the United States should begin a freeze alone; 30 felt that this move was only possible if the Soviets would do so as well. [10]

The response to question two was also revealing: 21 responded yes, when asked whether a nuclear was was likely; only seven believed that it would not occur; and eight felt that a nuclear was was possible or likely, but not very probable. The opinion was almost evenly divided on question seven, "Do you think it likely that the USSR would use nuclear weaponry against the USA or Western European nations?" Seventeen responded yes, and eighteen replied that it was not likely. [11]

Answers to question three were both mixed and confused: "What is the place of the threat of nuclear was in your life? Do you think about it at all? If so, how much of the time?" All of them replied that they had thought about it, but gave varied responses as to how the thought had affected them. A look at some of their answers may be more revealing than trying to reduce the response to mere numbers.

One girl replied: "The threat of nuclear war plays a great role in my life when (her emphasis) I think about it. I seldom think of the whole mess." [12] Another girl wrote: "Although I am not constantly thinking about it, the thought of a nuclear war scares me to death. The times I think about it most are when I hear something on the radio or television concerning the matter." [13] The response of a young man, who was a Cadet Brigade Commander of an Army Junior ROTC summer camp: "Nuclear war scares me only when I really think on it. I only think on it when I am alone and there is no communication." [14] One girl wrote that she knew indirectly "that nuclear weapons have affected all of our lives. I do not think about these things often, because it frightens me to know that I have no say on the issue of nuclear weapons, and that basically, my life is in the hands of strangers." [15]

When asked to respond to the policy of M.A.D. (Mutual Assured Destruction), nine students replied that they knew little or nothing about it. Sixteen thought that the policy was sensible; while nine found the whole idea absurd. Most of the reactions were both confused and anguished as in the following: "First of all, I don't like the idea of M.A.D. at all. Second of all, I think there shouldn't even be need for such a policy. What I mean by this is that no country should possess such power that it could jeopardize the safety of the world . . . . Maybe there should be, but I don't know all the facts." [16]

A final look at a response reveals a great deal of the confusion, ignorance and anguish in young people, at least at Culver, about nuclear weaponry and the threat of nuclear war. One respondent, a Cadet Captain, and captain of the ice hockey and soccer teams, replied as follows to the last question, "What do you think the USA should do about nuclear weaponry?" His response, "Compromise to bag the whole freaking ordeal." [17]

What does all of this mean? What do I make of the responses of my students? I find them confused, anguished, concerned, incredibly ignorant and uniformly apocalyptic about the issues at stake -- and yet I cannot, dare not, dismiss what they say. Why? For two reasons. First, because they represent the thinking of powerful, conservative, elites in the Middle West. If their parents share their views, then this is added evidence for a growing dissatisfaction of key sectors of the American public with our defense policy and our policy makers. [18] Second, and perhaps more importantly, I find that their anguish, confusion and concern strikes a chord in me. Nuclear weapons are insane -- no truly rational creature would ever create such a weapons system that could, so we are told, cause the possible destruction of his own species. The real tragedy is not the fact of nuclear weapons, but that man seldom acts rationally. Even to contemplate the world in a full scale nuclear war is to conjure up scenes from the Final Judgement --Dies irae, dies illa, solvet saeclum in favilla -- "Day of wrath, o day of mourning, . . . heaven and earth in ashes burning."

With all due respect to Herman Kahn and "thinking about the unthinkable," the young recoil in horror, and rightly so, at the prospect of a nuclear war. In the words of a seventeen year old cadet at Culver: "Nuclear War is a threat to my life. I think about it often, for I want to be given a chance to live a normal life. I want children after me to have the same chance. I don't want everything I've waited and longed for to be taken away." [19] The young man echoes the

sentiments of no less a person than Pope John XXIII, who wrote in <u>Pacem in Terris</u> that "nuclear weapons should be banned . . . It is hardly possible (he wrote) to imagine that in the atomic era war could be used as an instrument of peace." [20]

There is a natural and wholly reasonable desire for peace and a recoiling from the real horrors of nuclear warfare. It does little good for me to argue, as I would have done on many occasions, that a nuclear freeze hastens the possibility of a nuclear war rather than makes it less likely. The appeal of peace and the anguish at the fact of nuclear horror is almost too great to overcome. Unless advocates of current nuclear policy can show that their policy is, <u>in fact,</u> more moral than those advocating a nuclear freeze, or some other easy answer, then we will increasingly lose support among key elites in this country.

I will argue that it is the Middle West which sets the tone and basic orientation of America, i.e., the way we see ourselves, the rest of the world, and our policies toward the world, military, or non-military. I cannot dispute the tremendous power and significance of the East Coast -- of Boston, New York, or Washington, D. C.; the growing significance of the South; or the powerful trendsetting West Coast. I would still argue, however, that it is the Middle West which has set and still sets the basic American orientation toward itself and the rest of the world. I will also argue that the education of elites, in the case of Culver, a largely Middle Western elite, can only work upon the basic attitudes of mind shared by the people of the region they come from, or go to school in. Hence, if there is visible erosion of support for current American nuclear nuclear policy, that could signify a significant seachange on the part of key American elites signalling the possible de-legitimation of nuclear policy among those groups.

Let me make my point clear about the influential position of the Middle West in the United States and the essentially mid-western character of Culver. Although Easterners, Southerners, and Californians would dispute it, I believe that the real heartland of America is the Middle West: the region between the Appalachians and the Rockies -- north of Memphis and stretching to Canada. Since 1932, the majority of our Presidents have either been Middle Westerners, or have had their basic attitudes shaped by that region; Hoover, Truman, Eisenhower, Nixon, Ford and Reagan. Two of that group, although Californians, largely exemplify Middle Western values. A minor, though not insignificant, fact is that the dominant radio and television voice in America is Middle Western; announcers are taught to speak with a flat Middle Western accent. Even the recent growth of the Sun Belt -- the South West and the South -- has been tremendously influenced by the Middle West as people from that region settle there. Grant, for the moment, that the Middle West has had a significant impact upon the United States. As for Culver, the majority of our students come from Indiana, Ohio, Illinois, Wisconsin, Michigan, Missouri and Kentucky. Students from those states set the tone for the school, although we have a significant group from the South and from Latin American, especially Mexico and Venezuela.

What are the basic attitudes and character traits which we have to deal with at Culver when we teach them about the US and the world, let alone discuss more detailed matters like the US Nuclear Policy? I will argue that Americans tend to exhibit certain largely unchanging orientations towards the rest of the world and

America's place in it. These are virtually unchanging qualities of mind, but, on the other hand, these very qualities can sometimes produce startling changes in thought and action -- this, I will argue later, is what one sees in changing perceptions about national nuclear policy.

In the first place, most Americans are profoundly ambivalent about the rest of the world -- take Europe, for example; we are fascinated by it and yet despise it at the same time. We find foreign places nice to visit, but we are glad we don't have to live there. We wish fervently that the rest of the world would stop causing us problems! Second, as a people, we believe passionately that all problems have relatively simple solutions; in addition to that, we have great faith that committees -- groups of people working together with good will, can formulate solutions to those problems. Third, many Americans have what some call a Sunday-School mentality towards foreigners and foreign affairs: a belief that all people are basically alike, and that all international problems can be settled easily with a little good will. Fourth, despite all the talk about Americans being motivated by pragmatic considerations, whether it be profit, or protecting our national interests, most of us instinctively seek a moral answer, a moral position in world affairs. We think of ourselves, as President Reagan quoted, "as a city set upon a hill," and "the last best hope of mankind." How, then, could we act in anything other than a moral manner?

Here is where the problem begins and ends with our nuclear policy; increasing numbers of Americans see it as senseless and immoral. If that perception continues to grow -- and the gulf widens between key elites and policy makers and implementers, then we will have serious problems maintaining a credible nuclear policy.

Let me return to a point made earlier. Many Americans, particulary in my region -- the Middle West -- persist in seeing all problems as having simple solutions that can be arrived at by men of good will. We continued to believe that even after our sad experiences in attempting to save the world for democracy in 1917. This attitude was reinforced as a result of our involvement in the Second World War, by the defeat of the Axis Powers and the relative ease of the Marshall Plan and NATO in rebuilding and defending Europe from Communist Russia. The continuing faith that many Americans still place in summit meetings reflects that attitude. At the same time, however, there is a strong undercurrent, with roots in immigrant feelings, and in the basic, primordial, instinct of Americans, that we would be better off turning our backs on the rest of the world. If our solutions don't work -- then it must be the fault of the people over there. If things become more of a mess because of our efforts, then we had better leave things well enough alone. The revulsion against the Korean War and the even stronger reaction against the Vietnam War underscore that attitude. Former Presidential Candidate George McGovern's theme of "Come Home, America" evoked a powerful response in many Americans -- yet we know that we can't come home, we just wish we could! This feeling is especially powerful in my region. Underlying all of this is this thrust -- this deep wish on the part of Americans to seek a moral solution -- to have their nation act as a moral leader of the world. Whether we always act morally is quite another matter, but when increasing numbers of Americans perceive that their country is acting immorally -- then we have trouble.

The coming together of moralistic and isolationist elements is all too clear in our precipitate withdrawl from Vietnam. It has happened once and could happen again; perhaps the Europeans double nightmare has some basis in reality; one, that the Russians will come, and two, that the Americans will go.

The final underlying element in our basic orientation is a deep-seated suspicion of the Soviet Union and her intentions towards the US and the rest of the world. Many Americans do see the Soviet Union and the USA in the words of former President Richard Nixon, "as the equivalent of Good and Evil, Light and Darkness, God and the Devil." Detente was never really popular in the Middle West. What was popular was finding Soviet markets for our grain, but that didn't mean that we had to trust or like the Russians: business was one thing -- even international business; politics is another -- even international politics.

In the past few years, there seems to have been a return to more traditional values; after a period of withering anti-militarism, many Americans are viewing the. military and other once scorned traditional values and institutions in a kinder light. The long dominant "liberal" view of the world which criticized and ridiculed traditional values is on the wane. One author writes of our period as a time when "Liberalism indeed seems like a dynasty fast losing the Mandate of Heaven. On the ascendency is traditionalism, challenging liberalism on every major front and ending the liberal monopoly of the agenda setting process. On every critical policy matter, liberals must share the platform with traditionalists. 21

The military is on the verge of becoming intellectually fashionable again. I can state that I teach in a military school without immediately being perceived as a protofascist. The perceived threat of aggressive and threatening Soviet Communism, whether correct or incorrect, has led many Americans to re-evaluate their view of the military. The decisive handling of the Falkland Islands crisis by Britian through the controlled use of military force has also contributed to the ongoing re-evaluation of the military.

Yet it is at precisely this time, when we appear to be in the midst of a traditional revival in America, when key elites are showing signs of breaking with our national nuclear policy. Not only is this true about the United States, but of many of our Western European allies as well. Peace movements have sprung up all over Europe, but are most powerful in Germany, the Netherlands and Great Britian. The NATO decision to install MX and Pershing Missiles has brought long dormant organizations, like the Campaign for Nuclear Disarmament, out of their slumber. It is too early to tell their impact upon Western military policy, but it has clearly resulted in the hesitation of the Dutch government to support their NATO allies. It has caused the British Labor Party to announce publicly its decision to overturn the decision to place MX and Pershings in Britian and to seek an immediate freeze on nuclear weapons manufacture and placement.

It would be tempting, but tragically incorrect, to dismiss the European Peace Movement or our home-grown movement as the result of Communist manipulation. Though that is certainly present, the real motivator is moral -- the horror of nuclear war and repudiation of Western nuclear policy.

There are signs that a growing peace movement may have a significant impact upon our nuclear policy; already, key elites are showing impatience with American nuclear policy. The delegates of both the American Lutheran Church and the Lutheran Church in America voted overwhelmingly for "the elimination of nuclear weapons from the earth." They urged the leaders of the United States and the Soviet Union to see that we are locked "in an arms race which both countries find almost impossible to stop." The United States should "invite the Soviet Union and other nations to join us in a freeze and in a step-by-step reduction of the number of warheads and delivery vehicles. [22] That same week, the general convention of the Episcopal Church was asked to consider proposals allowing "unordained persons . . . to administer communion and officiate at marriages," after a nuclear war. "The main intent of the proposals seems to be to encourage Episcopalians to ponder the consequences of nuclear warfare." [23] The House of Bishops of the Episcopal Church issued a pastoral letter in which they questioned the American nuclear policy of deterrence, asking "how can this policy be squared with a free nation's commitment to justice when it intends the calculated killing of millions of human beings who are not themselves on trial? We hold such an intention to be evil." [24] The Bishops of the Roman Catholic Church of the United States "are on the brink of challenging the moral acceptability of certain essential features of the nations's nuclear policy, namely, the intention to make the initial use of nuclear weapons in war and the policy of retalitating for Soviet nuclear attacks by nuclear attacks on the adversary's cities." [25] The bishops' pastoral letter, God's Hope in a Time of Fear, "may cut more deeply still into current military doctrine, going as far as to ban all use of nuclear weapons." [26]

While the offical U.S. policy is still to foreswear the use of nuclear first-strike, it is not insignificant that American Roman Catholic Bishops see a discrepancy between our official stance and our intention to employ first-strike tactical nuclear weapons in the event of a Warsaw Pact invasion of Western Europe. Their concern about this matter, and that of other key elites, signals a significant shift in public perceptions about U.S. nuclear policy. It is increasingly viewed as based on the strategic first-strike use of nuclear weapons. This is, in fact, not our policy, but many Americans perceive it as the policy of their Government. This perception lends credance to the tendancy of numbers of Americans to dismiss our nuclear policy as inherently immoral. Their perception is, as I have already noted, based, in part, on a real discrepancy between official doctrine and tactical policy and exigencies in the European theater.

It is not my intention to discuss the wisdom, let alone the prudence, of these actions, if indeed those virtues can be applied in any sense to these decisions. What I must do is to sound a warning that the advocates of American nuclear policy are in danger of losing the high moral ground which they must have, if there is to be national support for our military and civilian nuclear policies. If I am correct in focusing on the moral thrust in American character, then it becomes critical that the majority of our citizens not see current nuclear policies as senseless and immoral.

Moral concerns matter greatly to Americans; when the public comes to perceive something as immoral, support will be withdrawn from it -- people may even refuse to tolerate its continued existence. In the past, such a significant shift on the

part of the public occurred on the slavery issue between 1820 and the 1860's. Similar shifts in public perceptions took place during the Civil Rights struggle in the 1950's and 1960's, and most recently, during the Vietnam War.

Complicating the tendency of Americans to perceive many issues as simple, susceptible to easy solutions, is this aversion to seeing themselves and their nation as acting immorally. On top of this, the young are particularly susceptible to simplistic solutions. Part of the response of the young people surveyed in Boston and those I teach at Culver, was a tendency to turn inward -- to dismiss the whole notion of nuclear weaponry as one which frightened and scared them -- so they simply wouldn't think about it. One difficulty resulting from that attitude is that it leaves the individual particularly susceptib to simplistic solutions which appear to solve the problems, i.e., a nuclear fr ze, or some other simplistic panacea.

The appeal of peace and letting the individual alone to do his own thing is very strong, particularly among the young. John Lennon captured this romantic, individualism in his song "Imagine." The lyrics reveal other aspects of the problem of educating young people to see the realities of world politics and nuclear policy. Many simply do not want to see those realities, preferring instead to escape into a romantic, fantasy world where all problems are resolved in an individualistic Utopia:

> "Imagine there's no heaven
> It's easy if you try.
> No hell below us,
> Above us only sky.
> Imagine all the People
> Living for the day.
>
> Imagine there's no countries,
> It isn't hard to do.
> Nothing to kill or die for,
> And no religion too.
> Imagine all the people
> Living life in peace.
>
> Imagine no possessions
> I wonder if you can.
> No need for greed or hunger
> A brotherhood of Man.
> Imagine all the people
> Sharing all the world.
>
> You may say I'm a dreamer
> But I'm not the only one.
> I hope someday you'll join us
> And the world will be as one." [28]

The tendency of young people to turn inward, also drives them to seek simplistic solutions to various problems facing them. The national phenomenon in the appeal of fundementalist Christianity to many young people is probably related

to this quest for simple answers to complex problems. This dual movement -- to seek simplistic solutions to complex problems and the turning inward raises a number of questions directly related to the physical security of nuclear weapons, i.e. , safeguarding the weapons and deploying them upon command.

The apocalyptic concern of the young about nuclear weaponry, <u>unless properly</u> <u>addressed in training</u>, could result in a lack of predictability in the capacity to deploy nuclear weapons upon command. This may become more of a problem if religious groups declare the possession, let alone the use of nuclear weaponry, as immoral. If the behavior of people deploying a weapons system is not predictable, this will limit and constrain the command structure employing the weapons system. The predictable fact of carrying out orders is the best assurance that the order to use the weapons will never be given.

In a sad way, we see once again that the advocacy of a nuclear freeze, and the possibility of encouraging disobedience to orders -- both justified on moral grounds -- tend to increase the chances of nuclear war, not lessen it. Both positions may force the command structure, when faced with a crisis, toward inflexible either/or decisions. The employment of morally absolutist doctrines in national security matters tends to create outcomes not desired by those holding such views.

On October 24, 1982, <u>The New York Times</u> echoed this point in an editorial opposing the nuclear freeze as a "simplistic, sloganeering response to a complex issue." [29] The editors pointed out that a freeze would "leave the Soviet Union with a large missile advantage in Europe, causing grave problems for NATO." [30] More ominously, the editorial suggested that adopting a freeze "would prevent the United States from counteracting the vulnerability of its land-based missiles -- a vulnerability that could become more dangerous than the size of either party's arsenal." [31]

In the light of what I have suggested up to this point, this conference has important work to do. While I have chosen to focus on some key issues in rather general terms, I believe that from this discussion we can draw the beginnings of a behavioral sciences research agenda for the Defense Nuclear Agency. Several specific matters suggest themselves as this point:

1. Social scientists should undertake specific research into the question of whether young people have clear, strong and general apocalyptic views about nuclear weaponry when the issue is brought to their attention.

2. There is some suggestion that young women may respond more strongly and negatively about nuclear weaponry than men, <u>when</u> the issue is raised to a high degree of salience. This matter needs further study; if this is found to be the case, then it needs to be addressed in training. Research needs to be done indicating the degree, if any, to which this becomes more of a concern when and if the woman considers the possibility of, or actually has, children.

3. Those selecting and training young people involved in nuclear site defense and deployment must realize (if my contention is correct) the necessity of overcoming deep-seated concerns about nuclear weaponry. These fears may not have been articulated seriously by the young person, but they are, I contend, none the

less, present, even in the likely non-elite recruits who will be trained to perform security functions in and around nuclear sites. These potential stresses have to be dealt with in training.

4.   Research should be conducted concerning the possibility of changing perceptions on the part of individuals working with nuclear weaponry. These perceptions may become increasingly negative if religious groups push toward declaring the mere possession, let alone the actual use of such weapons, as immoral.

5.   The Defense Nuclear Agency should use its capabilities and outside resources to assist responsible defense policy makers to define and conduct a dialogue with the public. This would include dialoguing with molders of public opinion from the media, religious, educational and civic groups -- most of whom come from and represent key elites throughout the country. There must be some attempt to educate our people about the complex realities of the nuclear issue. Even the French military acknowledges that ignorance on the part of their public about nuclear weaponry poses a threat to the continued existence of the force de frappe. The French public may respond negatively on this matter when it is raised to a high degree of salience. Some French military leaders appear willing to risk a possible adverse reaction by the public, lest ignorance cause an even more negative response. It is in our interest to encourage a similar dialogue in our own country.

6.   There should be preparation of the fact that the time for such a public dialogue may have already passed. If my perceptions are correct, when this matter is raised to a high degree of salience, many groups among the public become increasingly incapable of even tolerating the placement of nuclear sites near them -- let alone the discussion of nuclear strategy. If this is the case, then the Defense Nuclear Agency should prepare itself for what might become a major display of hostility, especially among the young, to nuclear weaponry. This may result in increased public demand, by the young, as opposed to the general public, to alter our nuclear policy with the threat of violent demonstrations at nuclear sites. Unlike past demonstrations at nuclear plant sites which were carefully orchestrated by small elites, this movement would represent a real outpouring of feeling among the young akin to the Vietnam Mobilization of the late 1960's. There is strong possibility that we might again see college campuses erupt with demonstrations -- this time against U. S. nuclear policy.

The kind of public educational campaign, if there is still time for one, must involve the young. While teenagers I teach at Culver are confused, anguished and incredibly ignorant about the realities of nuclear weaponry, they do want to learn the real facts. They have a right to be involved. It is, after all, their world too.

The public dialogue which I believe to be necessary to educate the American public on the real issues involved in nuclear weaponry has been prefigured by two perceptive writers: Francis X. Winters, writing in America, [32, 34] a centrist Roman Catholic journal published by the Jesuits of North America, and Flora Lewis for The New York Times. [33] Both see the vital need for reasoned and civil discussion of the issues. Winters sets the issue in terms of the pastoral duty of the bishops toward their flock: How to choose a political and military strategy which will defend the West from a malignant and limited Soviet view of the world.

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"To answer this question soundly, and to undertake the exacting measures required for lasting security, it is imperative that the choices confronting us be grasped accurately. It is no less crucial that our own choices be inspired precisely by the genius of our own civilization, which in many important features is a Christian one. We have then, in opting for one or other strategy of conflict, to take the high moral ground, first discovered by the shapers of our culture. We ought to side with those who believe, for instance, that while the right to wage war is indeed inviolable, it is likewise limited. We have to learn to observe those limits. If we are indeed serious about the depth of the East-West struggle we cannot go on allowing our military officers to plan the destruction of a whole society in an act of vengence that mindlessly mimics our adversary. Our struggle is precisely a contest of civilizations. It cannot therefore be won by brute force . . ."

Writing about the annual conference of the International Institute for Strategic Studies on the topic: <u>Defense and Consensus: The Domestic Aspects of Western Security</u>, Flora Lewis argued that we have been mistaken in the West "to allow the fateful issues of security to be cast either in esoteric terms beyond the voter's grasp, or in bumpersticker panaceas. To paraphrase the old saying, survival in freedom is too important to be left to professionals.

"At least the panjamdrums of events are now aware that people are watching and acting. The next step is to go beyond the equivalent of medieval mumbo-jumbo about the plague and medieval bleeding cures to some open-eyed look at realities. People who can make jets and use computers and understand antibiotics can also be rational about defense.

"It isn't necessary to know all the specifications of the B-1 or the nuclear physics of the 'fratricide theory' for the MX missile 'dense packs' bases to judge if they are needed. When the experts can't agree and can't answer sensible questions convincingly, their words shouldn't be law.

"I repeat my favorite quote from Albert Einstein. 'Make everything as simple as possible, but no more so.' The search for consensus on defense requires making evident sense. That may not be easy, but it's the nub."

In the closing words of Father Winters, "We have, in short, a reasoned argument to make. And miles to go before we wake."

APPENDIX

Culver Nuclear Questionnaire

1. How old were you when you first became aware of nuclear weaponry?

2. Do you think that a nuclear war is likely? If so, how might it occur? What might be the results -- to the U.S.A. -- to the rest of the world?

3. What is the place of the threat of nuclear war in your life? Do you think about it at all? If so, how much of the time?

4. Do advances in nuclear weaponry affect your thinking about the future and your view of the world?

5. What is your reaction to the policy of M.A.D. (Mutual Assured Destruction)? Is it a feasible policy for the U.S.A. and the U.S.S.R. to follow?

6. What do you think of the idea of a freeze on the manufacture and placement of nuclear weapons? If you agree, state why -- if you disagree, state why not. If you agree, should the U.S.A. pursue this whether the U.S.S.R. does so or not?

7. Do you think it likely that the U.S.S.R. would use nuclear weapons against the U.S.A. or Western European nations?

8. What do you think the U.S.A. should do about nuclear weaponry?

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1. Salience can be defined as that dimension of a person's attitude and opinion which pertains to the degree to which a particular topical issue is truly important to that individual when being questioned. "Whether or not that issue is on his mind at that time," he will volunteer views on it, as something which concerns him. There is a paradox here, for, as a rule, public policy issues do not have a high degree of salience even when they are presented to the individual. The young people I questioned at Culver were not preoccupied with nuclear issues; they seldom thought about them as a matter of fact. When questioned about them, however, they had clear, strong, and generally uniform views on the issue.

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11. Ibid.

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32. Francis X. Winters, "Catholic Debate and Division on Deterrence," p. 131.

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